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THE EFFECTS OF SEVERAL VERBAL PRETRAINING CONDITIONS ON PRESCHOOL CHILDREN'S TRANSFER IN PROBLEM SOLVING. FINAL REPORT.

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THREE- AND 4-YEAR-OLDS WERE GIVEN VERBAL LEARNING PRETRAINING TO DETERMINE ITS EFFECT UPON THE PERFORMANCE OF REVERSAL AND NONREVERSAL SHIFT DISCRIMINATION TASKS. THE EXPERIMENTAL TASK WAS THE CLASSICAL REVERSAL-NONREVERSAL SHIFT PARADIGM. THE 96 PRE-SCHOOLERS, PRIMARILY FROM THE PENNSYLVANIA STATE UNIVERSITY NURSERY SCHOOL, WERE DIVIDED INTO 4 GROUPS, 3 OF WHICH RECEIVED PRETRAINING AND 1 OF WHICH DID NOT. THE DATA COLLECTED WERE TREATED BY ANALYSIS OF VARIANCE. RESULTS SHOWED THAT THE REVERSAL SHIFT WAS QUICKER AND EASIER FOR THE CHILDREN THAN THE NONREVERSAL. A SECOND EXPERIMENT USING 48 CHILDREN CONFIRMED THESE FINDINGS ALTHOUGH PREVIOUS EXPERIMENTAL RESULTS AND VERBAL MEDIATION THEORY HAD INDICATED THAT THE NONREVERSAL SHIFT WAS EASIER FOR THE CHILDREN. OTHER VARIABLES SUCH AS THE CHILDREN'S PROFICIENCY IN VERBAL MEDIATING RESPONSES MAY HAVE CAUSED THE PRESENT STUDY RESULTS, BUT THE RELATIONSHIP BETWEEN VERBAL LABELING PRETRAINING AND TYPE OF SHIFT REMAINS INCONCLUSIVE. FURTHER STUDIES SHOULD DETERMINE WAYS TO IDENTIFY AND ISOLATE VARIABLES WHICH AFFECT THE ABILITY OF YOUNGSTERS TO PERFORM EXPERIMENTAL TASKS. THIS DOCUMENT WAS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY AT PENNSYLVANIA STATE UNIVERSITY. (MS)

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Gloria D. Bernheim

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The Pennsylvania State University

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The Effects of Several Verbal Pretraining Conditions on Preschool Children's Transfer in Problem Solving

A thesis in

Educational Psychology

by

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TABLE OF CONTENTS

Page

Acknowledgments ii

List of Tables iv

List of Figures vi

I. INTRODUCTION 1

II. REVIEW OF THE LITERATURE
  Early studies 7
  Reversal-nonreversal shift paradigm 10
  Optional shift technique 17
  Overtraining. 21
  Retardates 22
  Alternative hypotheses 27
  Summary. 37

III. EXPERIMENT I
  Purpose 39
  Method 42
  Results 48
  Discussion 57

IV. EXPERIMENT II
  Purpose 59
  Method 64
  Results 66
  Discussion 73

V. DISCUSSION 77

VI. SUMMARY. 89

REFERENCES 94

APPENDIX A Means and Variances 98
  B Raw Data 103

LIST OF TABLES

Table Page

1. Means and Standard Deviations of Trials to Criterion on Discrimination Shifts.............. 29

2. Means and Variances for Six Groups on the Concept Attainment Task........................ 31

3. Number of Ss Responding in Each Category During Test Series................................. 34

4. Analysis of Variance of the Number of Trials to Reach Criterion on the Learning Task: Experiment I................................ 50

5. Mean Number of Trials to Reach Criterion on the Learning Task: Experiment I................ 51

6. Analysis of Variance of the Number of Trials to Reach Criterion on the Transfer Task: Experiment I................................ 53

7. Mean Number of Trials to Reach Criterion on the Transfer Task: Experiment I................ 55

8. Analysis of Variance of the Number of Trials to Reach Criterion in Learning Task: Experiment II............................... 68

9. Mean Number of Trials to Reach Criterion on the Learning Task: Experiment II............... 69

10. Analysis of Variance of the Number of Trials to Reach Criterion on the Transfer Task: Experiment II...................... 71

11. Mean Number of Trials to Reach Criterion the Transfer Task: Experiment II.................. 72

12. Average Means and Variances for the Transfer Tasks: Experiments I and II.............. 75

LIST OF TABLES

Table Page

13. Means and Variances of Trials to Criterion on Learning Task: Experiment I 99

14. Means and Variances of Trials to Criterion on Transfer Task: Experiment I 100

15. Means and Variances of Trials to Criterion on Learning Task: Experiment II 101

16. Means and Variances of Trials to Criterion on Transfer Task: Experiment II 102

17. Number of Trials to Criterion on Learning for Three-Year-Old Ss: Experiment I 104

18. Number of Trials to Criterion on Learning for Four-Year-Old Ss: Experiment I 105

19. Number of Trials to Criterion on Transfer for Three-Year-Old Ss: Experiment I 106

20. Number of Trials to Criterion on Transfer for Four-Year-Old Ss: Experiment I 107

21. Number of Trials to Criterion on Learning: Experiment II 108

22. Reversal Shift Transfer Task: Experiment II Number of Trials to Criterion 109

23. Nonreversal Shift Transfer Task: Experiment II: Number of Trials to Criterion 110

LIST OF FIGURES

Figure Page

1. Example of a reversal and a nonreversal shift.. 2

2. A single unit and mediational S-R analysis of a reversal and a nonreversal shift............. 6

3. Modified reversal-nonreversal shift procedure.. 14

4. The effect of verbalizations on a reversal shift.. 15

5. Illustration of one of the arrangements of stimuli and reinforcement used in the optional shift technique......................... 19

6. Shift choices of subjects........................ 20

7. Number of correct responses in blocks of five trials for the reversal shift condition only, Experiment I.......................... 56

Chapter I

INTRODUCTION

In recent years interest in the role of verbal responses in concept formation and problem-solving has been stimulated through application of stimulus-response behavior theory to cognitive processes. A typical controversy, and the one with which this paper is primarily concerned, involves the distinction between predictions of performance of a binary discrimination task based on single unit stimulus-response theory (Spence, 1936) compared to predictions based on a two-stage verbal mediation hypothesis (Kendler & Kendler, 1962).

A discrimination task commonly used in experimental investigations of these two theoretical positions is the now classical reversal-nonreversal shift paradigm. This task involves the presentation of paired stimuli that vary on two dimensions simultaneously; brightness (black and white) and size (large and small). In the learning trials one cue of one dimension is always reinforced (e.g., white). When the S learns to respond only to the relevant cue, disregarding either cue of the irrelevant dimension (e.g., white-small and white-large stimuli), transfer trials are initiated with no interruption in procedures. The transfer task is either a reversal (intradimensional) or a nonreversal (extradimensional) shift. If, as in the above example, white was reinforced during learning and the transfer condition is a reversal shift, black would then be reinforced. If the transfer task is a nonreversal shift, then one cue of the other dimension (e.g., either small or large) would be reinforced during the transfer trials. This paradigm is illustrated in Figure 1.

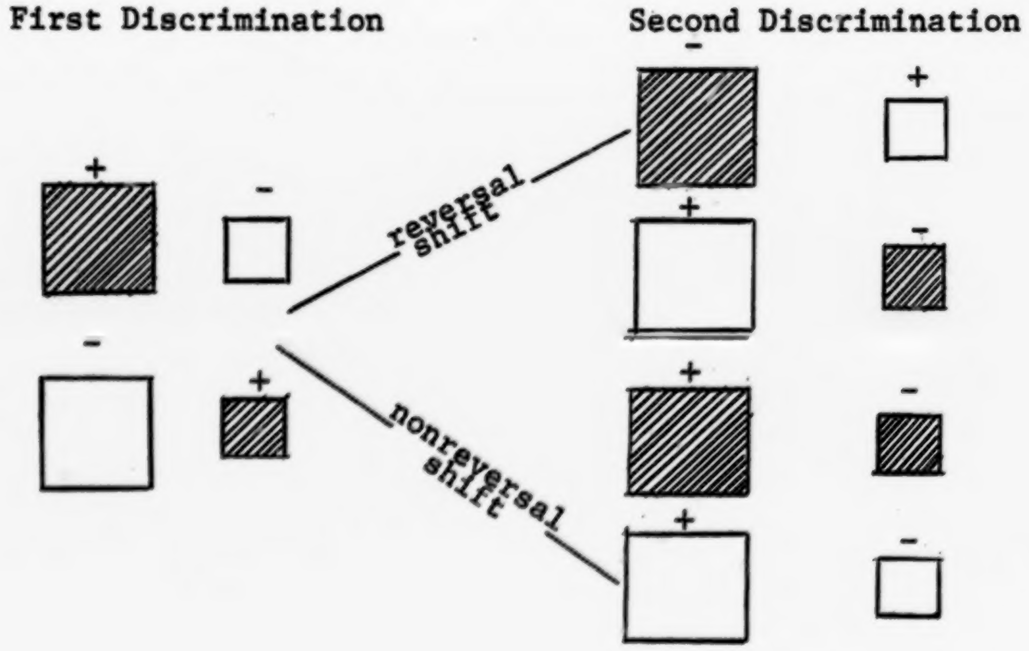

Figure 1. Example of a reversal and a nonreversal shift. (From Kendler & Kendler, 1962, p. 5.)

According to single unit S-R theory, a nonreversal or extradimensional shift should be executed more rapidly than a reversal shift. This prediction is based on the assumption that the cues of the dimension irrelevant during the learning trials were randomly reinforced 50% of the time. On the other hand, the nonreinforced cue of the relevant dimension was associated with nonreinforcement 100% of the time. Accordingly, a shift during the transfer trials to a previously irrelevant cue would be acquired more rapidly than a shift to the opposite cue of the previously relevant dimension.

Results obtained using the reversal-nonreversal shift paradigm have not been totally consistent with the predictions based on single unit S-R theory. Although the performance of animals on these two transfer shifts is as predicted, the performance of adult Ss is not. This conflicting evidence led Kendler and Kendler (1962) to posit the verbal mediation hypothesis. They proposed that, in addition to the single unit S-R bond, adult human Ss utilize a covert mediating bond. During the learning trials the stimulus elicits a cue-producing response that serves to mediate the final overt response, as follows:

S———r.......s———R.
(cue-producing
mediating response)

This mediating response is often thought to be a covert verbal response.

Contrary to the prediction based on single unit S-R theory, a reversal shift would be predicted to be executed more rapidly if the hypothesized verbal mediating response is assumed to be present. For example, if in the original learning trials the white stimulus is positive, the S is assumed to give a verbal mediating response such as "color" or "brightness" while learning the initial discrimination. After criterion is reached and black becomes the positive cue for the reversal shift condition, the mediating response is still appropriate since the dimension of brightness is again relevant. Only a new overt response to the black cue needs to be learned. When the shift is a nonreversal one (to the previously irrelevant dimension) the mediating response developed during the initial learning trials is no longer relevant. Accordingly, in addition to the new overt response, a new mediating unit (r...s) must also be developed. A comparison of the two predictions can be examined by means of Figure 2 in which an analysis of reversal and nonreversal shifts is made on the basis of both single unit theory and mediational theory.

Differential predictions based on phylogenetic level can readily be extrapolated from these two theoretical positions. That is, the verbal ability of human Ss should facilitate reversal shift performance whereas the lack of verbal ability in animals should result in more rapid performance of a nonreversal shift. Such differences in performance on the reversal-nonreversal shift transfer tasks have been demonstrated. Rats, primates, and very young children, in accordance with single unit S-R theory, perform a nonreversal shift more rapidly than a reversal shift. Adults and older children, in accordance with the verbal mediation hypothesis, have been found to perform a reversal shift more rapidly than a nonreversal shift. Although the performance of adults does question the validity of predictions made from single unit S-R theory, it does not give experimental evidence for the intervening, unobservable verbal mediating response and its associated stimulus. The studies reviewed in the subsequent chapter have primarily been concerned with this experimental evidence.

The purpose of the present investigation was directed toward a closer examination of the nature of verbal mediating responses. In order to determine the extent to which such responses control overt choice behavior, three- and four-year-old children were presented with two types of verbal labeling training that were based on theoretical descriptions of verbal mediating responses. Since children of this age do not normally display behavior indicative of mediating responses, if the performance of _S_s with no verbal labeling training is compared to that of _S_s with training, it was anticipated that experimental evidence of the development and role of mediating responses in discrimination learning would be obtained.

SINGLE UNIT THEORY

	Reversal Shift	Nonreversal Shift
First Discrimination	$S \text{ ——— } R_{\text{black}}$	$S \text{ ——— } R_{\text{black}}$
Second Discrimination	$S \text{ ——— } R_{\text{white}}$	$S \text{ ——— } R_{\text{large}}$

MEDIATIONAL THEORY

	Reversal Shift	Nonreversal Shift
First Discrimination	$S \text{ — } r_{\text{color}} \ldots s \text{ — } R_{\text{black}}$	$S \text{ — } r_{\text{color}} \ldots s \text{ — } R_{\text{black}}$
Second Discrimination	$S \text{ — } r_{\text{color}} \ldots s \text{ — } R_{\text{white}}$	$S \text{ — } r_{\text{size}} \ldots s \text{ — } R_{\text{large}}$

Figure 2. A single unit and mediational S-R analysis of a reversal and a nonreversal shift. (From Kendler & Kendler, 1962, p. 6.)

Chapter II

REVIEW OF THE LITERATURE

The studies which have been included in this review of the literature fall into two main categories. The first and largest group of studies all involve the verbal mediation hypothesis. Of these, the earlier studies provide background data leading to the initial formulation of the hypothesis. The later studies were specifically designed to test the hypothesis either through (a) a direct experimental manipulation of a verbal response such as pretraining with verbal labels, or (b) the use of a variable which is thought to be highly correlated with the probable use of verbal mediating responses such as age or overtraining. The second and smaller group of studies were designed to test some hypothesis alternative to verbal mediation. Except for the earlier experiments, all of the studies utilize some form of the reversal-non-reversal shift paradigm.

The Verbal Mediation Hypothesis

Verbal Labeling in Earlier Studies

Two early studies (Kuenne, 1946; and Cantor, 1955) indicated that verbal labels in a discrimination task facilitated transfer. Kuenne did not directly manipulate verbal responses but based her study on the assumption that mental age and the use of covert verbal responses in discrimination learning are correlated. A difference was found between the high and low mental age groups' performance on the near-far transposition problem (Spence, 1936). Briefly, this problem requires S to discriminate between two stimuli that are large and small. The absolute size of each stimulus and the ratio of the area of the two stimuli is constant throughout the learning trials. There are two transfer tasks: a near test and a far test. In both, the ratio of the area between stimuli is held constant, while the absolute sizes of the stimuli differ from those in the learning trials. In the near test, the size is similar to the stimuli used in the learning trials but, for the far test, the size is quite dissimilar. On the basis of single unit S-R theory, it would be predicted that the performance on the near test should be at a level similar to that reached during the learning trials. However, for the far test, the level of performance should decline from that reached during learning in relation to the degree of difference between the stimuli used during learning and those used during the transfer trials.

Kuenne found that the performance of the younger children (mental age of 42 months) was consistent with this prediction but the performance of the older children (average mental age of 76 months) on the near and far tests was essentially equal. The results were interpreted as indicating that the discrimination behavior of the older subjects was controlled by covert verbalization of the essential cue (such as "bigger"), this verbalization being equally valid for both the near and the far test. Thus, when verbal responses are present as inferred from the mental age of the S, performance on the two transfer tasks are equal. When verbal responses are inferred as absent (e.g., in younger Ss), there is significant discrepancy in performance on the two transfer tasks.

The second of these two early experiments (Cantor, 1955), employed groups of three-, four-, and five-year-old Ss. There were three experimental conditions of pretraining in which two separate pairs (A and B) of stimuli, consisting of simple but distinctly different drawings of faces, were used. The Ss in the first (relevant-pretraining) experimental condition received pair A faces and were taught a name (Jean and Peg) for each face. The Ss in the second (irrelevant-pretraining) experimental group were treated identically but with pair B faces and two different names (Pete and Jack). The third (attention) group was presented with pair A faces but instead of learning to name them they were asked to attend to and point out parts of the faces. Transfer consisted of two-choice discrimination with pair A faces for all conditions. Using the dependent variable of number of correct choices over all trials, the results indicated that relevant verbalization facilitated transfer. That is, the relevant verbal label group performed significantly better than either the irrelevant or attention groups which did not differ significantly from each other. There were no significant differences attributable to pretraining when the number of trials to reach criterion was used as the dependent variable. The effect due to the three age classifications and interactions with age were not significant. Cantor concluded that the possession of names for the stimuli in a learning task had enhanced the performance on that task.

In a general discussion of the "acquired distinctiveness of cues," Spiker (1956), in reference to an experiment by Norcross and Spiker (1957), concluded, in agreement with Cantor, that preliminary discrimination experience with the relevant stimuli was not in itself sufficient to facilitate performance of a subsequent discrimination task. Verbal labels appeared to be the key factor.

The experiments discussed above do not exhaust the literature of studies in which verbal responses were found to be an important factor in various types of discrimination tasks. Nevertheless, they are typical of such experiments since they involved either covert verbal responses as inferred through the age of the Ss, or a direct manipulation of verbal responses as variables of importance in human problem solving. Because the main concern of this paper is the role of these variables in the reversal-nonreversal shift paradigm, the remaining studies to be reviewed will be limited to those using this paradigm or some modification of it.

Reversal-Nonreversal Shifts and Verbal Labeling

A series of early studies (Buss, 1956; Harrow & Friedman, 1958; and Kendler & D'Amato, 1955) using the classical reversal-nonreversal shift paradigm, indicated that college Ss, contrary to predictions based on single unit S-R theory, performed a reversal shift more rapidly than a nonreversal shift. This finding led to another study (Kendler & Kendler, 1959) using the reversal-nonreversal shift paradigm with young children as the subject of investigation. The use of young children as Ss was crucial to the identification of the developmental level in humans at which the change in behavior occurs from a more rapid performance of a nonreversal shift (predicted from single unit S-R theory) to a more rapid performance of a reversal shift (predicted from a hypothesis of verbal mediation).

In this study (Kendler & Kendler, 1959) kindergarten children were used as Ss in an experiment employing the classical reversal-nonreversal shift paradigm. They found (using number of trials needed to reach a criterion of nine out of ten successively correct responses as the dependent variable) no differences in the performance of Ss on reversal and nonreversal shifts. It was hypothesized that the reason for obtaining no differences was because children at this age (58 to 78 months) were in a mediational transition period. Accordingly, it was assumed that some of the children had developed effective verbal mediators while others had not. In a further exploration of this hypothesis the Ss were divided, in a *post hoc* examination of the data, into fast and slow learners on the basis of their initial learning trials (above and below the median number of trials needed to reach criterion). This analysis revealed that fast learners had performed a reversal shift significantly faster than slow learners and slow learners had performed a nonreversal shift significantly faster than fast learners. It was concluded that fast learners were mediators and performed according to verbal mediation theory while slow learners were non-mediators and performed in a manner consistent with single unit S-R theory. However, it must be noted that this conclusion was based only on post-experimental reorganization of the data and did not involve the direct manipulation of a variable related to verbal responses. Hence, the cause for the differences in shift performance between the fast and slow learners is open to various interpretations other than verbal mediation theory; for example, that of the dominant orienting response (Wolff, 1966).

Another study conducted by Kendler, Kendler and Wells (1960) was designed to investigate further the interaction between age and transfer to type of shift suggested by the aforementioned experiment. The Ss were nursery school children with an age range from 33 to 63 months. Verbal labeling was manipulated by requiring the Ss to label the cues of the relevant dimension of both the rewarded and nonrewarded stimuli for ten reinforced trials after criterion was reached on initial learning and before the transfer shift was initiated. For example, they had to say "white is right; black is wrong." Difference scores (number of trials needed to reach criterion on initial learning minus the number of trials to criterion on transfer) were used as the dependent variable. No effect attributable to the verbalization condition was found. The nonreversal shift was, as would be expected with children of this early age, somewhat easier than a reversal shift. However, there was no interaction between instructions to verbalize and type of shift. Presumably the requirement to verbalize at the end of the learning trials should have facilitated a reversal shift.

Subsequently, Kendler (1963) used a slightly modified reversal-nonreversal shift paradigm with somewhat contradictory findings. The Ss were four and seven years old. The conditions of verbalization were relevant, irrelevant, and no instructions to verbalize. As illustrated in Figure 3, only one pair of stimuli (large-black and small-white) was used during the initial learning trials. Verbalization was manipulated by requiring the Ss to give a verbal label (black, white, big or little) to the cue of the correct stimulus on each trial during learning. One-third of the Ss labeled a cue of the size dimension, one-third labeled the brightness dimension and the remaining third were not required to verbalize. After the learning trials, all Ss were presented the reversal shift task; that is, the small stimuli of the two pairs were reinforced. Thus, Ss who had been required to verbalize in terms of size during learning were called "relevant verbalizers," those who had been required to verbalize in terms of brightness were called "irrelevant verbalizers."

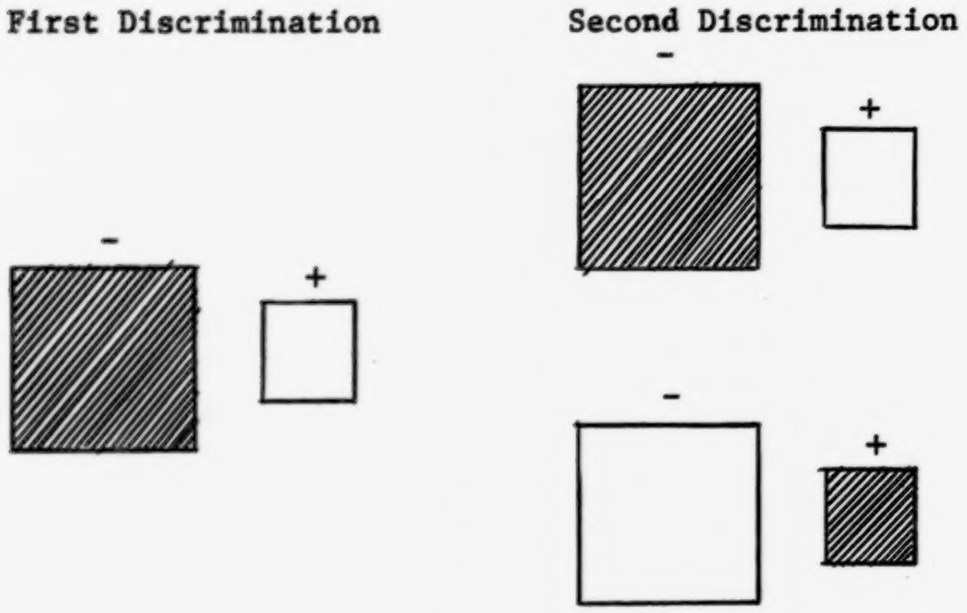

Figure 3. Modified reversal-nonreversal shift procedure. (From Kendler & Kendler, 1962, p. 10.)

The results reported in Figure 4 suggest, but not at an acceptable level of significance, that four-year-old Ss profited from the use of relevant verbal labels whereas seven-year-old Ss did not. In contrast, the seven-year-old Ss appeared to display more interference effects.[1]

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[1] This experiment has been discussed in two general review papers (Kendler, 1963; and Kendler & Kendler, 1962) but neither one has given reference to the original report of the study.

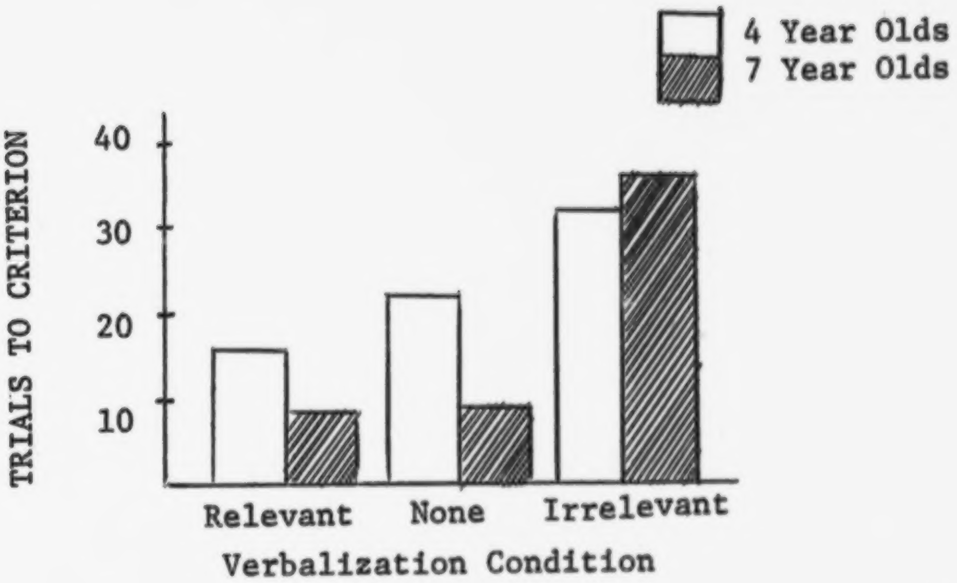


Figure 4. The effect of verbalizations on a reversal shift. (From Kendler & Kendler, 1962, p. 10.)

The distinction in the requirement to verbalize is also important in relation to a study by O'Connor and Hermelin (1959). Their experiment was essentially a replication of the previously described Kendler study but their Ss were retardates. The retardates who were required to verbalize, performed the reversal shift much like that of a no-verbalization control group of normal preschool Ss (matched with the retardates on the basis of MA). Retardates who were not required to verbalize were superior to both the normal controls and the verbal-retardates. In other words, verbalization interfered with subsequent reversal shift performance. As in the previously cited Kendler study, the Ss verbalized only one cue during the learning trials whereas in the Kendler, Kendler and Wells study, Ss were required to label both the positive and negative cues during learning.

To summarize these studies, all of similar design, the Kendler, Kendler and Wells (1960) study, using kindergarten children as Ss, found no differences in reversal shift performance attributable to a verbalization condition which required labeling both the rewarded and nonrewarded stimuli. The Kendler (1963) study, requiring verbalization of only one cue, gave some indication of facilitation, especially for the four-year-old Ss. But more important, the use of verbal labels during learning trials that were subsequently irrelevant during transfer produced the greatest amount of interference with the seven-year-old Ss. The O'Connor and Hermelin (1959) study demonstrated interference effects for retardates from verbalization of one cue during learning.

The observation that younger Ss are not as affected by the use of verbal labels as are older Ss (i.e., post kindergarten) led Reese (1962) to formulate the hypothesis of a stage of development characterized by mediational deficiency. He refers to an observation made in Kuenne's (1946) early study where, in a post experimental analysis of the Ss' ability to verbalize the relevant cues of the stimuli, it was found that there was very little correlation between this ability and their actual discrimination performance. Kuenne (1946) concluded that:

> . . .there are at least two developmental stages so far as the relation of verbal responses to overt choice behavior is concerned. In the first, the child is able to make differential verbal responses to appropriate aspects of the situation, but this verbalization does not control or influence his overt choice behavior. Later, such verbalizations gain control and dominate choice behavior (p. 488).

Luria (1957) suggested a similar hypothesis when he stated that "In the early stages of child development, speech is only a means of communication with adults and other children. . . .Subsequently it becomes also a means whereby he (the child) organizes his own experience and regulates his own actions (p. 116)."

In a more recent experiment (Silverman, 1966) results were obtained which are contradictory to the mediational deficiency hypothesis. The reversal shift performance of two age groups (three- to four- and seven- to eight-year-old Ss) were compared, with and without the requirement to label their stimulus choices. It was found that the younger Ss profited equally as much as the older Ss from the requirement to verbalize: both age groups that labeled the stimuli performed the reversal shift in significantly fewer trials than the Ss that were not required to verbalize. It is important to note that in this experiment, unlike the procedure used in previous studies, the Ss labeled the stimuli after the shift. Silverman concluded that "One possible reason why a mediational deficiency was not observed in this study is that the verbal responses were elicited during the reversal phase (p. 7)."

The Optional Shift Technique

Kendler and Kendler (1962) accomodated their original verbal mediation hypothesis and the mediational deficiency hypothesis by proposing a three-stage hierarchy of development: They stated that:

> Reversal choice reflects the highest level; here covert verbal responses occur during the training and also

> serve to mediate behavior. Nonreversal constitutes an intermediate level at which covert verbal responses can occur and sometimes do, but either occur rather late in learning or they do not readily or necessarily mediate overt behavior. The most primitive level is characterized by little or no overt responses and is manifested by inconsistent choice behavior (p. 583).

On the basis of the foregoing proposition Kendler, Kendler and Learnard (1962) designed a study in which the traditional reversal-nonreversal shift paradigm was greatly modified. Since there appeared to be a discrepancy between a child's ability to verbalize his actual overt discrimination behavior, direct manipulation of the verbalization variable was abandoned and instead a technique was developed to classify children into three stages of development on the basis of their actual overt choice behavior. In this experimental procedure (the K, K & L optional shift technique illustrated in Figure 5) the child learns the initial two choice discrimination (Series I) in the traditional manner, but, in the second series of trials, only one pair of stimuli are presented. After a criterion of nine out of ten successively correct responses is reached with this single pair of stimuli, a third series is presented in such a manner that the children can be classified as (a) mediators (those choosing a reversal shift), (b) nonmediators (those choosing a nonreversal shift), and (c) inconsistent (those displaying inconsistent choice behavior). In Series III the pair of test stimuli are both reinforced. _S_s are classified as mediators if they make eight or more responses to, for example, the white stimulus of the test pair. They are classified as nonmediators if they make eight or more responses to the black stimulus and as inconsistent if their responses to either stimulus of the test pair do not reach this criterion.

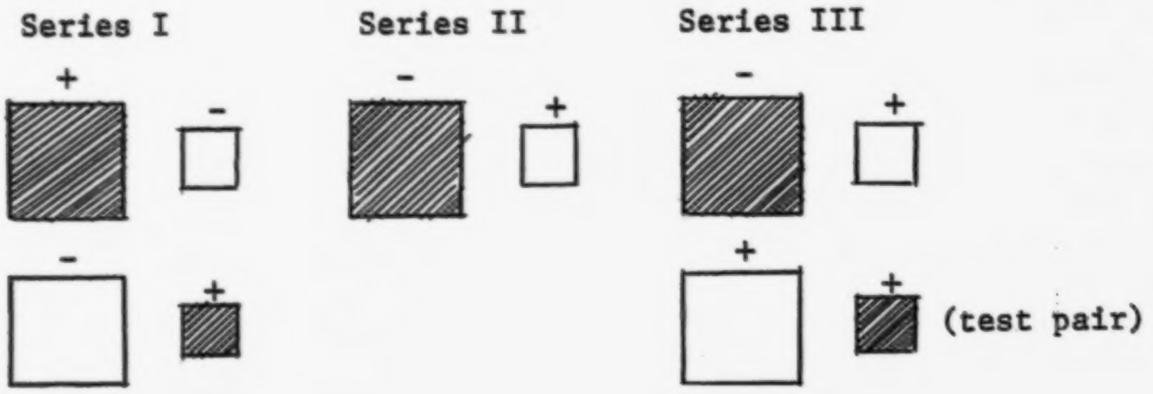


Figure 5. Illustration of one of the arrangements of stimuli and reinforcement used in the optional shift technique. (From Kendler, Kendler & Learnard, 1962, p.575.)

The analysis of the results of this study consisted of an examination of the Age x Shift interaction. That is, the authors examined the percentage of Ss in each of the five age categories (three, four, six, eight and ten years) who were classified as reversal, nonreversal and inconsistent. A significantly higher percentage of Ss in the ten-year-old group compared to the three-year-old group chose a reversal shift rather than either of the other two categories of transfer choice. The plot of this interaction is reported in Figure 6. The authors interpreted these results as supporting the verbal mediation hypothesis. Thus, older children utilize verbal mediators more than younger children and hence would be expected, as a group, to choose a reversal shift on the Series III trials. However, this is indirect evidence for the use of verbal mediating responses because there was not a direct manipulation of verbal responses.

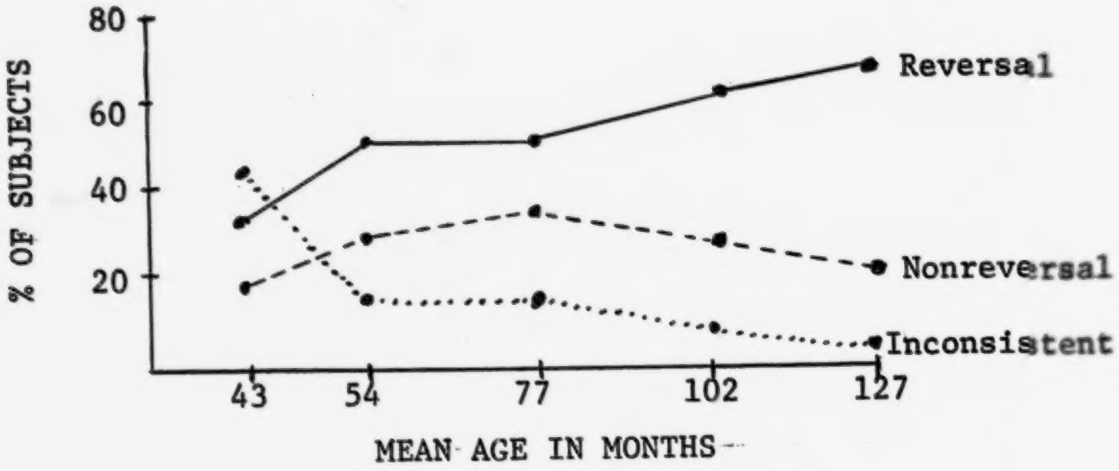


Figure 6. Shift choices of subjects. (From Kendler, Kendler & Learnard, 1962, p. 576.)

In a subsequent experiment (Kendler, 1964) using the K, K & L optional shift technique, kindergarten Ss in the experimental condition were required to [illegible] each choice response with a sentence that labeled the correct and incorrect stimulus of the relevant dimension. A significantly greater proportion of Ss who had been required to verbalize subsequently chose a reversal shift in the Phase III test series than control Ss who had no verbalization requirement.

In conclusion, the previous studies have all attempted to demonstrate the role of a verbal mediation response in the reversal-nonreversal shift discrimination task. Several of the studies have indicated an interaction between ease of a reversal over a nonreversal shift and the age of the Ss, thus giving indirect support to the verbal mediation hypothesis. Other of the studies have involved a direct experimental manipulation of verbal labeling responses. The majority of these studies, in which the classical reversal-nonreversal shift paradigm was used, have indicated an age at which the requirement of overt verbal responses has little facilitating effect on learning by younger (i.e., pre-kindergarten) Ss and results in the "mediational deficiency hypothesis." Only the recent study of Silverman has been able to clearly demonstrate a facilitating effect for younger children from the requirement to verbalize their choice of stimulus. Nevertheless this experiment differed from the others in the important respect that the Ss were required to verbalize their choices after the reversal shift. One additional experiment with kindergarten children demonstrated a facilitating effect due to the requirement to verbalize but the K, K and L optional shift technique employed was a radical methodological departure from the classical reversal-nonreversal shift paradigm on which the original verbal mediation hypothesis was formulated.

Reversal-Nonreversal Shifts and Overtraining

Another variable of current interest due to its inferred relationship to verbal mediation is that of overtraining. The hypothesis is that for children who are developmentally at a stage of mediation, overtraining (a given number of trials beyond criterion in original learning) should increase the strength of the verbal mediator for the relevant dimension. Accordingly, a facilitating effect on a reversal shift should be observed together with an inhibitory effect on a nonreversal shift due to an increase in the strength of the verbal mediation response.

In an experiment with first grade Ss, Youniss and Furth (1965) found that overtraining (15 and 25 trials) facilitated a reversal shift. However, contrary to expectation, overtraining did not interfere with a nonreversal shift. They concluded that:

> Apparently overt choices on the preshift task are increasingly controlled by implicit responses established with increased training and not alone by individual S-R bond strengths, and subsequently the implicit responses mediate in shift performance (p. 427).

In agreement with the Youniss and Furth (1965) results, Tighe and Tighe (1965) using six-year-old children as Ss, found that 30 overtraining trials did facilitate the reversal shift. Their control Ss (no overtraining) did not differ on speed of learning between the reversal and nonreversal shifts. In their discussion they offer the following explanation:

> This experiment provides further evidence that overtraining enables young children to accomplish discrimination shifts in a manner similar to that exhibited by mature humans. . . .The overtraining condition of the present experiment might be interpreted as having afforded the children additional opportunity to develop the appropriate mediating responses. . .(p. 366).

Kendler and Kendler (1966) using the K, K & L optional shift technique investigated 16 vs. 36 overtraining trials in a crossed design with two age levels, four to five and eight to nine years.

They offered an alternative prediction for the effects of overtraining which is based on single unit S-R theory. Presumably, overtraining during learning trials builds a stronger S-R bond to the relevant cue than training just to criterion hence necessitating more extinction trials before a reversal shift can occur. Thus, on the basis of single unit S-R theory, it would be predicted that overtraining would inhibit the speed of performing a reversal shift transfer task. Conversely, on the basis of the verbal mediation hypothesis, overtraining would be predicted to facilitate the speed of performing a reversal shift. Hence, there should be an increase in the age differences in shift choice using the K, K & L optional shift technique as a result of overtraining trials. The results of this study, in contrast to the two previous overtraining experiments, indicated that overtraining had no effect on either type of shift. Age was the only significant factor identified in this study. A greater percentage of older subjects chose a reversal shift than did the younger Ss regardless of the amount of overtraining.

A recent study (Ohlrich & Ross, 1966) compared a group of retardates receiving 125 overtraining trials with a control group receiving no overtraining. It was found that overtraining did facilitate a reversal shift. Other aspects of this study will be discussed in the section reviewing the literature in which retardates were used as Ss.

Eimas (1966a, 1966b) investigated overtraining in two separate studies. In the first of these he considered left-right position as a third dimension along with color and form as a possible basis for discrimination. The left-right position was the easiest task for the Ss, who were seven to nine years old, to learn. Overtraining was found to facilitate reversal shifts only for a difficult task. With the easiest (position), no such effect was noted. A second experiment in the same study revealed the finding that overtraining facilitated reversal shifts for older Ss (second grade) but retarded reversal shifts for younger Ss (kindergarten).

In another study with the same Ss as in the first, Eimas (1966b) used just two dimensions in the discrimination task (color and form) and zero and 50 overtraining trials. The significant interaction between age and overtraining was not replicated. Both reversal and nonreversal shifts were easier in the overtraining condition for all Ss. Curiously, in this experiment no significant effect due to age was found.

In summary, results of studies on the effects of overtraining on reversal shifts provide contradictory evidence for the hypothesis described in the introduction to this section. In three studies (Youniss & Furth, 1965; Tighe & Tighe, 1965; and Eimas, 1966a) some facilitation of a reversal shift was found for older Ss attributable to overtraining. However, no inhibitory effects on a nonreversal shift were observed. In his second study, Eimas found that overtraining facilitated both the reversal and nonreversal shifts. Kendler and Kendler, using the K, K & L optional shift technique, found no effects due to overtraining. Finally, Ohlrich and Ross found some facilitation with retardates due to overtraining.

Reversal-Nonreversal Shifts and Retardates

The two stage mediational process hypothesized by Kendler and Kendler (1962) would not predict an age by shift interaction with retardates as it would with normals. That is, normal, older Ss (post-kindergarten) make a reversal shift more rapidly than a nonreversal, while younger Ss perform a nonreversal shift more rapidly. In general, retardates would be expected to be verbally deficient and, thus, would lack the necessary implicit verbal mediating responses.

Contrary to this prediction, the earlier studies with retardates have generally found that a reversal shift is somewhat easier than a nonreversal shift. For example, House and Zeaman (1962) reported that for retardates of MA six to eight, reversal shifts were significantly easier than nonreversal shifts. O'Connor and Hermelin (1959) in investigating the reversal-nonreversal shifts with retardates had half of their Ss verbalize their choice during the initial learning trials. Their findings for the no-verbalization group were in agreement with the House and Zeaman results. However, Ss who were required to verbalize learned a nonreversal shift more rapidly than a reversal shift. Thus, verbalization appeared to have an inhibitory effect on reversal shifts.

Sanders, Ross and Heal (1965) attempted to further investigate these contradictory results in a later study where they also used, in addition to the retardate Ss, a group of normal third grade Ss of similar MA. The results of this study indicated that a reversal shift was significantly easier than a nonreversal. This is, of course, in agreement with the verbal mediation hypothesis. Furthermore, contrary to the House and Zeaman findings but also in accord with the verbal mediation hypothesis, there were no significant differences found in ease of a reversal vs. a nonreversal shift for the retardates.

Ohlrich and Ross (1966) investigated the role of overtraining in retardate performance of a reversal vs. a nonreversal shift. The control group of retardates, who did not receive overtraining, did not differ in their performance on a reversal compared to nonreversal shift. But the retardate Ss, who were given 125 overtraining trials after reaching criterion on original learning, learned a reversal shift more easily than a nonreversal shift. They state

> It appears probable that the mediating verbal and/or attentional processes which result in faster reversal shifts can result from either age related factors or specific overtraining procedures, and that retardates are deficient in these processes as compared to normals but not irrevocably so (p. 623).

In addition to facilitation on a reversal shift attributable to overtraining, they found that the color dimension was more difficult than the shape dimension and overtraining had its greatest effect on performance when color was relevant. This is in agreement with Eimas' results where it was found that overtraining procedures had the greatest effect on a difficult dimension. However, conclusions based on the results of the Ohlrich and Ross study must be tentative. They used only one subject in each cell. Since within cell variances in reversal-nonreversal shift studies are typically very large, the reliability of their results is questionable.

In summary, the House and Zeaman, and O'Connor and Hermelin studies found that for retardates of MA six to eight years, a reversal shift was somewhat easier than a nonreversal shift. This finding is contrary to the prediction that retardates because they are verbally deficient would not perform in a manner consistent with the verbal mediation hypothesis. Sanders, Ross and Heal found no differences between a reversal and a nonreversal shift. Ohlrich and Ross also found no differences between a reversal vs. a nonreversal shift with a retardate control group but overtraining facilitated a reversal shift.

Alternative Hypotheses

Other hypotheses have been suggested to explain the differences in efficiency of a reversal over a nonreversal shift and its relationship to age. All of these alternative hypotheses suggest the possible influence of an attending or observing response without the necessity of a verbal response.

Limiting Responses to Irrelevant Cues

Jeffrey (1966) hypothesized that the verbal label itself was not significant but rather that the requirement to label serves to focus the S's attention to a particular aspect or dimension of the learning situation and thus limits his responses to irrelevant cues. He gave six trials of learning-set training (object-quality discrimination) with no verbal labeling to half of his Ss who were four and ten years old, respectively. Using the K, K & L optional shift technique, he found no facilitating effects due to the learning-set training for either age group.

In a second experiment reported in the same paper, Jeffrey hypothesized that younger Ss take more trials to reach criterion on a reversal shift transfer task not because they lack mediators but because they fail to abstract a single cue from the stimulus composite. That is, they say "black-large" rather than just "black" or "large." On the basis of this he changed the stimuli from circles on the Series I trials of the K, K & L optional shift technique to squares on the two subsequent series of trials. The author predicted that the modified stimuli would reduce generalization from learning to transfer and hence also reduce the proportion of nonreversal shifts. In accordance with this predication, a greater percentage of four-year-old Ss did choose a reversal shift in the Series III trials. In fact, as many four-year-old Ss chose a reversal shift as did the six- and eight-year-old and college Ss. Age four was the youngest age level in this experiment.

Tighe (1965) also conducted a study designed to investigate the possibility that the differences in shift performance is due to the failure of younger Ss to abstract a single cue from the stimulus complex. The five- and six-year-old Ss in this experiment were given 30 minutes of nonreinforced perceptual pretraining designed to emphasize the independence and dimensional nature of the properties of stimuli used in the subsequent transfer task of the reversal-nonreversal shift paradigm. The perceptual pretraining task required the Ss to make same-different judgments between four standard stimuli and 16 comparison stimuli. All varied simultaneously on two dimensions; height and brightness. The results of this experiment are reported in Table 1 .

Table 1

Means and Standard Deviations of Trials to Criterion

in Discrimination Shifts

(adapted from Tighe, 1965, p. 383)

	Reversal	Nonreversal
Perceptual Pretraining	$\bar{X}$ = 5.6 SD = 6.77	$\bar{X}$ =17.1 SD =19.46
Control	$\bar{X}$ =15.2 SD =19.65	$\bar{X}$ =12.7 SD =17.63

The Ss who had been given perceptual pretraining performed a reversal shift significantly faster than the controls. It is possible that perceptual pretraining, like overtraining trials, may actually serve no function other than providing the Ss with extended exposure to the stimulus materials and hence sufficient time to develop appropriate verbal mediators. Tighe concludes that

> . . .this study does not enable a conclusive statement as to the relative contributions of perceptual vs. mediational factors to the observed facilitation of reversal behavior. But the consistency of the operations and data of the present experiment with differentiation theory warrants the view that further consideration be given to the possibility that differentiation processes play an important role in developmental changes in shift behavior (p. 384).

Dominant Responses for a Particular Dimension

In a rather radical departure from the reversal-nonreversal shift studies, Wolff (1966, 1967) stratified 60,six- to seven-year-old Ss on the basis of their shift choices during Series III trials of the K, K & L optional shift technique. Superior performance was predicted for Ss classified as mediators on a subsequent Osler (Osler & Powell, 1960) concept attainment task. The concept attainment task is a binary discrimination problem essentially the same as the learning trials of the reversal-nonreversal shift paradigm except that the paired stimuli consist of pictures of birds (reinforced) and flowers (nonreinforced), or birds (reinforced) and animals (nonreinforced). Wolff found no differences in the performance of Ss classified as mediators vs. nonmediators on this discrimination task involving stimuli for which they had appropriate verbal labels in their vocabulary. Thus the generalizability of facilitating effects on subsequent discrimination performance from the inferred ability to use verbal mediators is questioned. The two additional variables examined by Wolff were also related to verbal mediation. One of these consisted of conditioning verbal labeling responses to geometric shapes. The labels were relevant and irrelevant to the subsequent Osler concept attainment task (CAT). In addition, one-half of the group of Ss were required to label the stimuli overtly during the CAT; the other half had no such requirement. The results of this part of the experiment (reported in Table 2) indicated that both the pretraining condition and the requirement to label the stimuli during the concept attainment task facilitated learning.

Table 2

Means and Variances for Six Groups on
the Concept Attainment Task
(From Wolff, 1966, Table 2.)

	Verbal Label Preconditioning			
	Relevant	Irrelevant	None	
Overt Verbalizers	$\bar{X} = 18.6$ $S^2 = 845$	$\bar{X} = 23.0$ $S^2 = 843$	$\bar{X} = 59.2$ $S^2 = 716$	$\bar{X} = 33.6$
Nonovert Verbalizers	$\bar{X} = 60.3$ $S^2 = 1607$	$\bar{X} = 79.8$ $S^2 = 1041$	$\bar{X} = 75.0$ $S^2 = 737$	$\bar{X} = 71.7$
	$\bar{X} = 39.5$	$\bar{X} = 51.4$	$\bar{X} = 67.1$	

In another analysis of the data from this same experiment, Wolff, in a replication of the procedures used in the Kendler, Kendler and Learnard (1962) study, stratified the *Ss* on the basis of their original shift preference and then analyzed the speed of learning during the initial Series I trials. In agreement with the previous results, *Ss* classified as "reversers" learned the initial discrimination task the fastest, those classified as inconsistent learned the slowest, and those classified as "nonreversers" learned at a rate mid-way between the other two groups. The Kendlers explained this effect on the basis of verbal mediation: that is, *Ss* who choose a reversal shift are mediators and verbal mediation is likely to have a facilitating effect during learning trials. Wolff offered an alternative explanation: he posited a dominant orienting response (DOR). If the *S* comes to the experiment with a prepotent dimension, that is, if he spontaneously attends to one dimension over the other and is assigned by chance to a cue from this dimension during initial learning, his learning rate should be higher and a reversal shift made more easily. If the learning trials are on a non-prepotent dimension, learning should be slower and a nonreversal shift would be favored over a reversal shift. The alternative explanations were not adequately examined in this study.

Recently, Smiley and Weir (1966) hypothesized that the reversal and nonreversal shift choice in the last series of trials of the K, K & L optional shift technique could be explained by "dimension dominance." A definitive test of dimensional dominance vs. verbal mediation was not made, but a relationship between a dominant dimensional response and type of shift chosen on the final series of trials was found. The 87 kindergarten Ss were tested on two consecutive days for dimensional dominance (form vs. color). It was found that 66 met a criterion of consistency of dominant response; 54 showed a preference for form, and 12 for color. One-half of these Ss were then assigned to their dominant dimension and one-half to their non-dominant dimension for the Series I (learning) trials of the K, K & L paradigm. The measure was the number of Ss in each of these groups (dominant or non-dominant) who chose either a reversal or nonreversal shift on the Series III trials as well as those Ss who were inconsistent in their choices or who had failed to reach criterion during the Series I trials. These data are reported in Table 3. A chi-square analysis for the first four cells only indicated that the type of shift chosen was a function of whether or not the S was assigned to his dominant dimension during the initial learning trials. Those assigned to their dominant dimension chose a reversal shift and those assigned to their non-dominant dimension chose a nonreversal shift. In addition, a significantly greater number of Ss assigned to their non-dominant dimension failed to learn the initial learning task. The authors suggest that since 56% of the Ss classified as nonreversers had been assigned to their non-dominant dimension during the initial learning series (vs. 17% who had been assigned to their dominant dimension) these S̲s were not non-mediators, but simply mediating on a dimension inappropriate to solution. They concluded that "Whether such mediation is verbal, as the Kendlers (1959) suggest, or attentional (Lovejoy, 1966) is not made clear by this study (p. 304)."

Table 3

Number of S̲s Responding in Each Category
During Test Series
(From Smiley and Weir, 1966, p. 304)

Group	Reversal	Nonreversal	Inconsistent	Nonlearners
D	25	5	0	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Trabasso, Deutsch and Gelman (1966) also investigated a dominant orienting or observing response in a modified reversal-nonreversal shift paradigm. A pilot study with 53 two- to nine-year-old S̲s yielded the finding that younger S̲s learned the initial learning task more quickly than did older S̲s when only the brightness dimension was relevant. This observation, along with evidence from another experiment (Suchman and Trabasso, 1966a), indicated that brightness was a prepotent dimension for younger children and an important factor in discrimination learning. A further investigation of this hypothesis employed a modification of the stimuli used in the reversal-nonreversal shift paradigm so as to control the type of response to be transferred to the subsequent shift. These modifications resulted in three experimental conditions, all using unidimensional stimuli. In the first condition, essentially a reversal shift condition, both S-R conditioned responses as well as attentional or observing responses might be transferred. In the second condition (intradimensional) the post-shift discrimination involved the same dimension (i.e., color) but new cues were used. In this condition only observing responses can potentially be transferred. In the third condition (extradimensional shift) the post-shift stimuli are changed to a completely new dimension and potentially neither S-R nor observing responses can be transferred.

In the first of two experiments using this modified design, no significant effects related to the three conditions were found. There were 69 three- to five-year-old *S*s. It should be mentioned that an interesting sub-condition was added to the three main conditions. This fourth condition was the same as the reversal shift condition but the *S*s were also instructed at the time of the shift, that they were getting a new problem. This instructional set produced a significant reduction in post-shift error rate.

In their second experiment all factors remained constant except that three-dimensional stimuli were substituted for the two-dimensional ones used in the first experiment. Further, the condition using the instructional set at-time-of-shift was omitted. The authors hypothesized that an attentional or observing response would be more likely to transfer if the stimuli used were more salient: ". . .such as when the discriminada are objects rather than patterns (p. 16)." The intradimensional shift condition led to significantly faster shift performance indicating that an observing response was transferred. By comparison, the fact that the reversal shift condition showed slower shift performance indicates that although observing responses do transfer, prior instrumental habits fail to extinguish rapidly.

Summary

Several early studies found that older Ss performed a reversal shift more quickly than a nonreversal shift while just the opposite held for younger Ss. Kendler and Kendler (1959) subsequently identified kindergarten as the level of development where the transition from ease of a nonreversal to a reversal shift occurred. As a result, they posited the verbal mediation hypothesis in which covert verbal labels were thought to be used by the older Ss to facilitate reversal shifts by them.

A series of experiments were conducted with younger Ss to determine if the requirement to use overt verbal labels for the stimuli used in the discrimination task would facilitate reversal shifts. Only one experiment demonstrated a significant facilitating effect on reversal shifts as a result of the verbalization requirement. This study (Silverman, 1966) differed from the others in that the Ss were required to use the verbal responses during the transfer trials rather than the learning trials.

Another group of studies investigated either the effects of over-training procedures or the level of intellectual development (retardates) on reversal and nonreversal shifts. As with age, these variables were assumed to be correlated with the use of covert verbal mediating responses. The results of these studies were also inconclusive.

In an attempt to provide further experimental evidence for the hypothesized verbal mediating responses, Kendler, Kendler and Learnard (1962) devised the optional shift technique in which Ss were classified as mediators, nonmediators or inconsistent on the basis of whether they choose a reversal shift, a nonreversal shift or show no shift preference. A significantly greater proportion of older Ss were found to choose the reversal shift over the other two categories. Later Kendler (1964) found that the percentage of Ss choosing a reversal shift increased when they were required to label the stimuli overtly during the learning trials.

More recently, experiments have been conducted to investigate hypotheses other than that of verbal mediating responses to explain reversal-nonreversal shift differences. These have all involved an attending response such as the ability to attend to one cue of the stimulus complex, or a predisposition to attend to one dimension to the exclusion of the other(s). Most of these studies have found results supporting the importance of such responses but none have been successful in experimentally isolating the attending responses from the possibility that they are a result of, or synonymous with, verbal mediating responses.

Chapter III

EXPERIMENT I

Purpose

On the basis of verbal mediation theory, requiring Ss to use verbal labeling responses for the cues of the relevant dimension of the stimuli in the reversal-nonreversal shift paradigm should facilitate subsequent performance of the reversal shift. From the review of the literature it is apparent that the experimental evidence does not conclusively support this prediction.

Only two of the experiments reviewed (Kendler, Kendler & Wells, 1960; and Silverman, 1966) used the reversal-nonreversal shift experimental paradigm and three- and four-year-old children necessary for an adequate test of the hypothesized facilitating effects of training with verbal labels. The verbalization requirement was experimentally manipulated differently in each of the experiments. In the first (Kendler, Kendler & Wells) the Ss were required to label both the rewarded and nonrewarded cues of the relevant dimension for ten reinforced trials after criterion was reached on learning and before the transfer shift was initiated. No effect attributable to the verbalization condition was found. In the second experiment Silverman found that Ss of all ages investigated (three-, four-, seven- and eight-years old) profited significantly from the requirement to label the two cues of the relevant dimension. In this experiment the labeling took place after the shift and during the transfer trials.

In a discussion of the lack of facilitation of reversal shifts from requiring Ss to attach verbal labels to paired stimuli, O'Connor and Hermelin (1959) formulated the following hypothesis: If children who normally do not use verbal mediators are required to use a verbal response with their overt choice response in discrimination learning, it is comparable to requiring them to associate a nonsense syllable to a stimulus. As a result, both the overt response plus the verbal labeling response must be extinguished before a reversal shift can occur. In addition, both the verbal response and the overt choice response to the negative stimulus have been inhibited during the initial learning, thereby increasing the difficulty of performing a reversal shift during the transfer trials.

This position suggests that the Kendler, Kendler and Wells experiment was not an adequate test of the verbal mediation hypothesis. The experimental technique designed to make verbal mediators more salient in younger children possibly served only to condition meaningless verbal responses to overt choice responses. Furthermore, in their original formulation of the verbal mediation hypothesis, the suggested mediational response was a verbal label for the dimension of size or brightness (see Kendler & Kendler, 1962, pp. 6-7) rather than a verbal label for the cues black-white or large-small, as have been emphasized in previous experiments.

Based on these considerations, the present experiment examined the effects on a reversal shift of two conditions of verbal label pretraining. Pretraining was given prior to the commencement of the actual learning trials to avoid confounding the verbal responses with the reinforced overt choice responses in the reversal-nonreversal task itself. The first condition (successive labeling) was designed to emphasize the verbal labels for the specific cues of the stimuli, independent of the dimension to which they belonged. The second verbal pretraining condition (simultaneous labeling) was designed to emphasize the dimensional relationship of the specific cues of the stimuli in addition to presenting the verbal label for the dimension. Accordingly, it was hypothesized that the performance of the Ss in the simultaneous labeling (Si) condition would be superior to that of Ss in the successive labeling (Su) condition on a reversal shift.

On the other hand, Ss in both verbal labeling conditions were predicted to perform a reversal shift more quickly than those in either of the two control conditions. A same-different control (SC) condition was included to control for stimulus familiarization, warm-up, and learning-how-to-learn effects. In this condition the Ss were required to judge during pretraining whether the pairs of stimuli were the same or different, without reference to verbal labels. The other control condition was an absolute control (AC) with no pretraining and was included to establish replication of previous experiments using the reversal-nonreversal shift paradigm and to ensure a basis for evaluation of the experimental conditions of the present experiment.

In addition to the verbal labeling conditions, the relationship between age-of-subject and verbal pretraining was investigated. The Ss were stratified into two age categories; three- and four-years of age. The three-year-old Ss were predicted to show the greatest amount of facilitation from the verbal labeling pretraining conditions.

Method

Experimental Design

The experimental task used in the present experiment was the reversal-nonreversal shift paradigm illustrated in Figure 1 of Chapter I. However, brightness was the only dimension relevant during the initial learning trials. The design was a 2 x 2 x 4 factorial analysis of variance with two levels of age (three vs. four years), two types of transfer tasks (reversal and nonreversal shifts) and four verbal pretraining conditions (successive labeling, simultaneous labeling, same-different control, and absolute control).

Subjects

The Ss were 114 children, 61 boys and 53 girls, drawn from three nursery schools. There was no evidence that the Ss in the three schools differed systematically from each other. An equal number of three- and four-year-old Ss were used in the experiment. The average age of the three-year-old group was 42.7 months while that of the four-year-old group was 54.0 months. Within each nursery school the Ss were randomly assigned by reference to a table of random numbers to the four experimental conditions. There were no significant differences in the average age between the four treatment groups. Of the 114 Ss, 12 three-year-old and 6 four-year-old children were dropped from the experiment because of their inability to learn the initial discrimination. The 96 remaining Ss were distributed equally among the 16 cells of the experimental design.

Apparatus

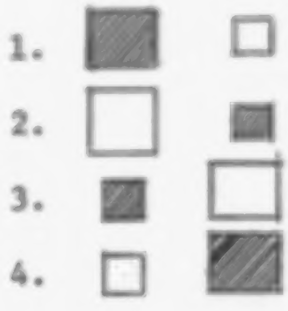
The portable wooden apparatus consisted of two 4 x 4 inch stimulus display panels of opaque glass. The stimulus materials were back-projected onto these panels by means of a Kodak Carousel Projector (K-800). The Ss responded to one of the stimuli by depressing the glass panel on which it was displayed. When a panel was depressed it made a slight clicking sound. The presentation of the pairs of stimuli was controlled by E.

In the center of the facade of the apparatus and just below the two windows was a hole for dispensing the marble reinforcements for correct responses. A Gerbrands Automatic Marble Dispenser was housed inside the apparatus. This was hand operated by remote control by E, who viewed the Ss' responses throughout the trials and dispensed a marble for each correct response. A trough was located at the base of the facade of the apparatus to collect the marbles.

Stimulus Materials

For the two verbal pretraining conditions and the same-different control condition, a deck of forty 4 x 4 inch grey pasteboard cards was prepared. On the grey face of each card a white or black geometric shape was centrally mounted. The geometric shapes were composed of an equal number of squares, triangles, rectangles, circles and half-circles. One-half of each of the shapes was black and the other half was white.

The stimulus materials for the learning and transfer trials consisted of 80 slides prepared for back-projection from the Kodak Carousel Projector to the two windows of the apparatus. Each slide contained one of the following distinct pairs of squares:



The projection of each member of each pair was centered in each of the two windows. The 80 slides were presented in random order within sets of four with no pair being presented more than twice in succession.

Pretraining Procedures

Each S was seen in one individual session which lasted from 20 to 40 minutes. The session began with verbal pretraining for all Ss except the absolute control group which immediately began the reversal-nonreversal shift discrimination task. The three groups receiving the pretraining were told that this was a practice session for the subsequent marble game.

The same general procedures were used in all three pretraining conditions. The 40 pretraining stimulus cards were randomly divided into two 20-card decks. E kept one deck and gave the other to S. They were seated across from each other at a small table. After E took a card from his deck and placed it on the table, the S was instructed to do the same and place it next to the other card. Depending on the condition to which he was assigned, S received one of the following sets of instructions.

Successive labeling. "Here is a black picture. Can you put another black picture next to it? These pictures are both _____." The S was expected to respond with the proper color name. This procedure was repeated for each of the 10 black-black and 10 white-white pairs, which appeared in random order. At no time was a verbal label denoting the dimension of brightness mentioned.

Simultaneous labeling. "When I put up a black picture, can you put one next to it that is the other color? Now tell me, what colors are these pictures?" S then gave the color names to the appropriate pictures. Half the cards introduced by E were white and the other half black, appearing in random order.

Same-different control. "When I put a card up like this, you put a card next to it. Are the two cards the same or are they different?" S responded by putting up any card from his deck and saying "same" or "different."

Reversal-Nonreversal Shift Procedures

The reversal-nonreversal shift task was introduced immediately after the pretraining conditions for all groups except the absolute control Ss who received no pretraining. The following instructions, which were essentially identical to instructions used in previous reversal-nonreversal shift experiments, were read to all Ss prior to the commencement of the learning trials.

> "When you play this game, you will win some marbles. You save all your marbles in this cup and at the end of the game you can trade them in on one of these prizes.
>
> See, there are two pictures here. One of the pictures is a winner and one is a loser. If you pick the winner, you will get a marble. If you pick the wrong one, nothing happens and you wait for your

> next turn. You tell the machine which one you pick by pushing the window just like this. Try it. Only push one window on each turn. After you push, two more pictures will come up and you get another turn to pick the winner.
>
> Remember, you pick the one you think wins a marble. If you are right, the machine will give you a marble. The machine always knows which one is the winner. It never makes a mistake. If you don't win a marble from the picture you pushed, on the next turn you can change your mind and try another picture. Sometimes the winner is in this window. Sometimes it is in this other window. Remember, the game is to see how you can win a marble on every turn."

The Ss were required, during the learning trials, to reach a criterion of nine out of ten successively correct responses. The reinforced cue was either black or white. After criterion was reached, half of the Ss were given a reversal shift transfer task, with the opposite cue of the same dimension reinforced. The other half was given a nonreversal or extradimensional transfer task with either the large or small cue reinforced. There was no interruption in the procedures from the learning trials to the transfer task. When an S reached a criterion of nine out of ten successively correct responses on the transfer task, he traded in his marbles for one of the small prizes displayed on a board.

Results

The data resulting from the first experiment were analyzed in two parts. The first analysis was of the data from the learning task. The second, and more important analysis, was of the data related to the post-shift discrimination tasks. It is the performance on these trials against which the purpose and specific hypotheses of this experiment were tested.

Learning

The primary purpose for analyzing the data from the learning trials of the reversal-nonreversal shift paradigm was to answer two related questions; (a) if rate of learning affected subsequent transfer performance, and (b) if the 16 experimental groups could be considered to have been equated on initial learning.

To answer the first question, the number of trials to reach a criterion of nine out of ten successively correct responses on the learning task was correlated with the same criterion on the transfer task. The obtained correlation ($\underline{r} = .065$) over all experimental conditions, was not significant ($p > .05$). This would indicate that if any experimental group were to show significant discrepancy from the others, this bias would not be likely to carry over into the transfer data and affect those results.

The second analysis of the learning data was a three factorial analysis of variance, using the same criterion of performance as the dependent variable, with two levels of age (three- vs. four-year-old *S*s), two types of transfer tasks (reversal and nonreversal shifts), and four levels of verbal pretraining (successive labeling, simultaneous labeling, same-different control, and absolute control). The results of this analysis, summarized in Table 4 , indicated main effects due to (a) the reversal-nonreversal shift classification ($F = 6.24$, $df = 1/80$, $p < .05$), and to (b) the four verbal pretraining conditions ($F = 5.27$, $df = 3/80$, $p < .01$). The effects due to age and to interactions were not significant ($p > .05$).

In Table 5 the mean number of trials to reach criterion on the learning task are reported. To obtain these means the data were collapsed across the age variable which was not a significant factor in the analysis of variance. In order to determine the specific sources of the effects obtained from the analysis of variance, the mean differences were examined for significance by the Scheffé method (see Winer, 1962, p. 88) for *a posteriori* multiple comparisons. Only one pair of means (same-different control:nonreversal and successive labeling:reversal) proved to be significantly different ($d = 62.00$, $p = .05$). It will be recalled that in the same-different control condition, the *S*s were asked to answer as to whether or not the stimuli were the same or different (the stimuli varied simultaneously in shape and brightness). The spontaneous verbal responses of the *S*s indicated that they were

TABLE 4

Analysis of Variance of the Number of Trials To Reach Criterion on the Learning Task

Experiment I

Source	df	MS	F	p
Age (A)	1	810.84	—	
Shift (S)	1	9700.26	6.24	<.05
Treatments (T)	3	8194.90	5.27	<.01
A x S	1	19.26	—	
A x T	3	343.93	—	
S x T	3	352.73	—	
A x S x T	3	3762.73	2.42	>.05
Within	80	1554.69		
Total	95			

TABLE 5

Mean Number of Trials to Reach Criterion on the Learning Task

Experiment I

Type of Shift	Absolute Control	Same-Diff. Control	Successive Labeling	Simultaneous Labeling
	Pretraining Condition			
Reversal	38.48	65.59	25.08	37.17
Nonreversal	47.17	91.17	48.41	59.91

attending to the various shapes of the stimuli to the exclusion of the black and white color. If this was so, then the negative transfer effect on rate of learning in this experiment from the same-different verbal pretraining might have occurred because only the brightness dimension was relevant during the learning trials. In effect these _Ss_ had inadvertantly been taught to attend to an irrelevant dimension.

In summary, the lack of correlation between learning and transfer and the fact that only one pair of means was significantly different, suggest that the differences among groups in learning the initial discrimination task would not affect the transfer performance in a systematic manner.

Transfer

The number of trials to criterion on the transfer task was analyzed by means of a 2 x 2 x 4 analysis of variance with two levels of age, two transfer tasks (reversal and nonreversal shifts) and four verbal pretraining conditions as the independent variables. Significant effects due to age ($F = 6.11$, $df = 1/80$, $p < .05$) and to type of shift ($F = 10.23$, $df = 1/80$, $p < .01$) were obtained as shown in Table 6. The effects due to the verbal pretraining conditions and to interactions were not significant ($p > .05$).

An examination of the means revealed that the significant effect for age was a result of the fact that in all conditions but one (simultaneous labeling) the performance of the

TABLE 6

Anaalysis of Variance of the Number of Trials
To Reach Criterion on the Transfer Task

Experiment I

Source	df	MS	F	p
Age (A)	1	4082.04	6.11	<.05
Shift (S)	1	6834.38	10.23	<.01
Treatments (T)	3	611.58	—	
A x S	1	8.17	—	
A x T	3	877.90	1.31	
S x T	3	689.74	1.03	
A x S x T	3	344.86	—	
Within	80	668.34		
Total	95			

four-year-old Ss ($\bar{X}$ = 45.43) on both the reversal and nonreversa shifts was superior to that of the three-year-old Ss ($\bar{X}$ = 58.48) The significant effect obtained for the reversal and nonreversal shift transfer tasks resulted from the relative ease of the revesal shift ($\bar{X}$ = 43.32) over the nonreversal shift ($\bar{X}$ = 60.39).

The above evidence for the relative ease of a reversal shi for three- and four-year-old Ss is in conflict with predictions based on the verbal mediation hypothesis. In addition, the predicted interaction between age and type of shift was not obtain. An examination of the means for each of the experimental cells (shown in Table 7) reveals that the three-year-old Ss took a greater number of trials to reach criterion on both types of transfer tasks.

Also contrary to predictions, there was no significant effect due to the verbal labeling conditions. Therefore, no statistic tests of the differences between the means were conducted. However, a comparison of the means of the strongest treatment condtion (simultaneous labeling) with those of the absolute control condition (see Table 7) indicates some facilitation of a reversal shift and interference of a nonreversal shift from the requirement to label the stimuli.

In a further analysis of these two conditions and their reationship to the age of the Ss, the number of correct responses or the reversal shift condition only were plotted in blocks of fiv trials (see Figure 7). The four-year-old Ss who received

TABLE 7

Mean Number of Trials to Reach Criterion on the Transfer Task

Experiment I

Type of Shift	Age	Pretraining Condition Absolute Control	Same-Diff. Control	Success. Labeling	Simultan. Labeling
Reversal	3	52.00	53.67	58.83	32.83
	4	32.50	44.17	36.17	34.00
Nonreversal	3	55.50	77.00	73.00	61.00
	4	46.17	41.83	60.83	67.83

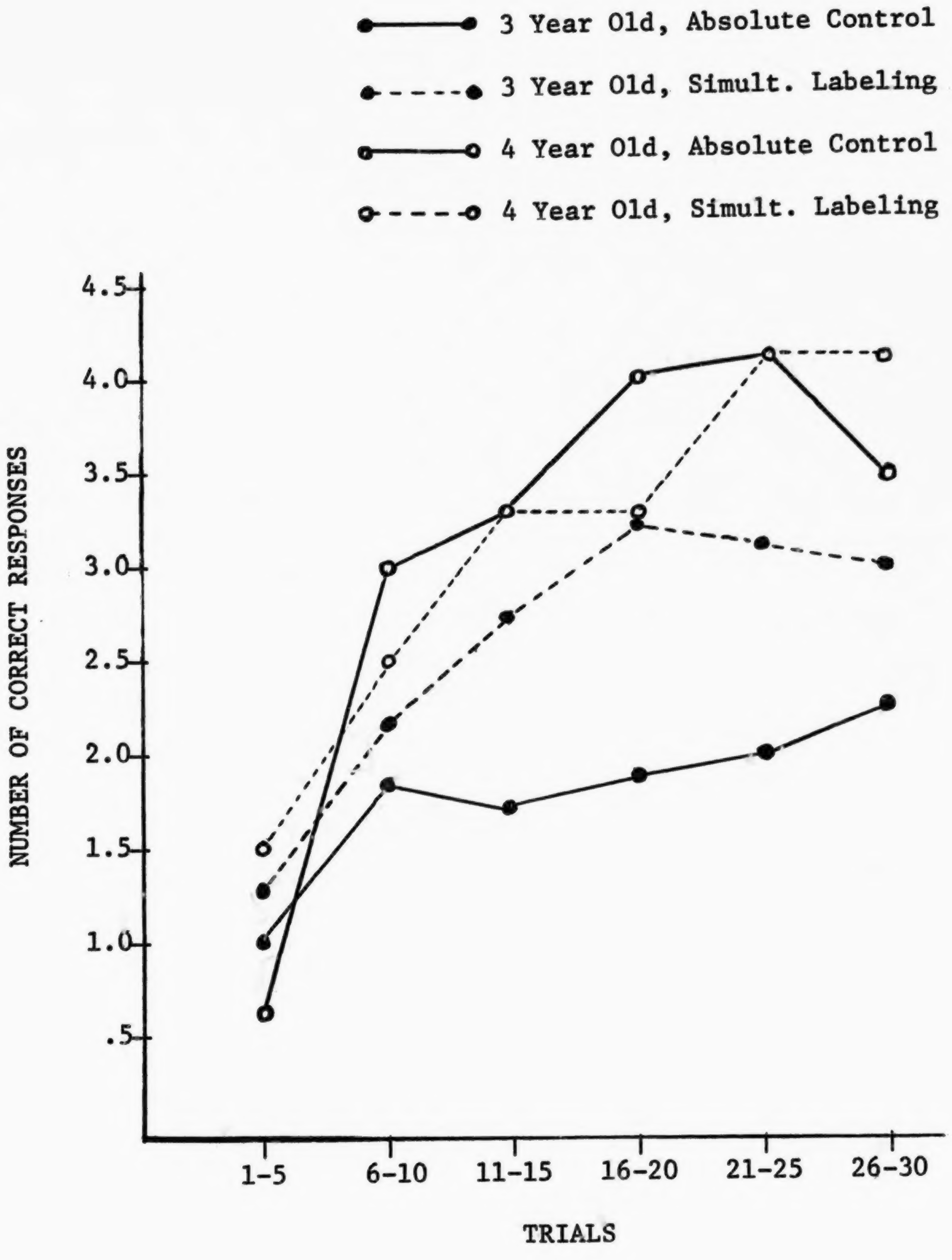


Figure 7. Number of correct responses in blocks of five trials for the reversal shift condition only, Experiment I.

simultaneous labeling pretraining did not perform differently from the four-year-old control condition. However, the three-year-old Ss in the verbal pretraining condition were more proficient on the transfer task when compared to the three-year-old Ss in the control condition. These observations, while consistent with the hypothesized interaction between the age of the subject and the facilitating effect of verbal pretraining, were not significant.

Discussion

The results of the first experiment in general are not in accord with predictions made on the basis of verbal mediation theory and previous experimental results. The relationship between verbal labeling pretraining and type of shift is inconclusive. Contrary to predictions, reversal shifts were generally easier than nonreversal shifts for these three- and four-year-old Ss. It is not surprising that the hypothesized facilitating effect of verbal labeling pretraining on a reversal shift was not obtained since the Ss were already proficient in their performance of a reversal shift.

In addition to the unexpected ease of the reversal shift and resulting lack of facilitation from verbal pretraining, the data indicate that the learning task and both transfer tasks were particularly difficult for these Ss . The means, when compared to those of other experiments, are high and the within-cell variances are quite large. These two statistics may indicate that the Ss were producing a large number of responses to irrelevant cues in the experimental situation. In addition, the large number of trials to reach criterion resulted in requiring the S to work at the task for a long period of time. The ability of three- and four-year-old children to attend to a task is limited. These two factors can produce unsystematic effects and are irrelevant to the purpose of the experiment. They may have served to mask experimental effects if they existed.

Chapter IV

EXPERIMENT II

Purpose

The purpose of Experiment II was to investigate further the following results of Experiment I which were inconsistent with theoretical considerations and the results of other investigations: (a) reversal shifts were performed more readily than nonreversal shifts by both three- and four-year-old Ss in all but one condition, and (b) the failure to identify differential effects from the verbal pretraining conditions on the transfer tasks.

A possible explanation for the results which are in contradiction with the assumed ease of a nonreversal shift over a reversal with young children may be indicated in the recent experimental work of Wolff (1967), Smiley and Weir (1966), and Trabasso, Deutsch and Gelman (1966). These studies have offered some form of a dominant attending response as an alternative explanation for reversal-nonreversal shift differences. According to this theoretical position, the S is assumed to attend to one dimension of the stimuli to the exclusion of the other. If this dimension is relevant during the initial learning trials, a reversal shift, which is intradimensional, is predicted to be performed more rapidly than a nonreversal shift because the latter requires a shift to the non-dominant dimension. If, as recent experimental results (Suchman & Trabasso, 1966a, 1966b) have indicated, brightness or color is a dominant response over size for three- and four-year-old children, the use of brightness as the only relevant dimension during initial learning would hypothetically result in facilitation of reversal shifts.

The results of the first experiment also did not support the predicted facilitation of reversal shifts from verbal labeling pretraining. One possible explanation for not obtaining the predicted results may reside in the fact that such a prediction is based on the assumption that for younger children nonreversal shifts are easier to perform than reversal shifts. This assumption proved to be invalid in the first experiment.

However, a second explanation is possible assuming the relative ease of the reversal shift was a procedural artifact in the first experiment. The lack of transfer from the pretraining conditions to the learning and transfer trials of the reversal-nonreversal shift paradigm may have been a result of changes in stimulus materials and presentation procedures. Although the stimulus materials used in pretraining were similar to those used throughout the learning and transfer trials, they were not identical. Furthermore, the pretraining stimuli were presented manually by _E_, while the stimuli of the learning and transfer trials were presented automatically in the apparatus. In fact, after completing the verbal pretraining, the _S_ was actually required to move to a different part of the room for the reversal-nonreversal shift discrimination tasks. These factors may have resulted in a lack of transfer between the two situations. In order to strengthen the verbal labeling pretraining and to facilitate transfer to the reversal-nonreversal shift paradigm, the following two procedural changes were initiated in Experiment II: (a) use of the same stimulus materials in pretraining as were used in the learning-transfer trials; and (b) presentation of these stimuli in the same apparatus.

In addition to the two above mentioned explanations for the lack of effects from the verbal pretraining conditions, two observed characteristics of the distributions of the data may also have weakened the predicted effects. Both observations indicate that the learning and transfer tasks were relatively difficult for the Ss.

First, the within-cell variances of the learning trials were quite large when compared to those of other reversal-nonreversal shift experiments. Large variances imply that the Ss were responding to irrelevant cues in the experimental situation. These responses can be reflected as "noise" in the dependent variable and mask experimentally produced differences where they may have existed. In order to reduce the task difficulty and hence the large variances, a correction procedure was used throughout the learning trials of the second experiment. This procedure, previously employed in a reversal-nonreversal shift experiment (Kendler, 1964), allows the S to make a second and correct response within a given trial if his first stimulus choice was incorrect.

The mean number of trials to reach criterion for both the reversal and nonreversal shift transfer tasks were, when compared with other studies, very high indicating that the transfer tasks were also relatively difficult. In fact, the means for the transfer trials were equally as high as those of the learning trials. Generally a reduction in task difficulty is anticipated from learning to transfer trials in paradigms of this kind due to learning-how-to-learn factors such as sophistication in operating the apparatus and appropriate use of the feedback properties of the marble reinforcers. Hypothetically, the relative difficulty of the transfer tasks may have resulted from the fact that younger children do not have the necessary problem-solving experience to correctly interpret either a reversal or a nonreversal shift as a shift in concept. According to Goss (1961) only with repeated problem-solving experiences does cessation of reinforcement for a previously correct response serve as a cue that the E has shifted the concept rather than that the concepts have not yet been learned.

Furthermore, consistent with Harlow's (1959) Error Factor Theory, in Experiment I there was observational evidence indicating that the majority of Ss entertained hypotheses irrelevant to a shift in concept to explain the cessation of the reinforcement after the shift. These irrelevant hypotheses were indicated by spontaneous statements such as "The machine is broken," "I didn't push hard enough," "It ran out of marbles," etc. This difficulty in interpreting the task increased the inattention of the Ss and may have resulted in directing their attention to irrelevant cues thereby increasing the frequency of errors and number of trials to reach criterion.

Other experiments in which verbal labeling requirements were found to be effective have used the K, K & L optional shift technique. The latter technique, as previously described, is a modification of the classical reversal-nonreversal shift paradigm and involves three important changes: (a) there is a procedural break between the learning and transfer trials, (b) new stimuli are introduced during the transfer trials, and (c) complete cessation of reinforcement for previously correct responses does not occur. Any one of these three changes could serve to implement the Ss' correct interpretation of the shift as a shift in concept, thus resulting in a reduction in the difficulty of the task and an increase in the probability of obtaining significant results from the experimental conditions.

In order to reduce the difficulty of the transfer tasks of the classical reversal-nonreversal shift paradigm, in Experiment II an instructional "set" at the time of the shift to the transfer tasks was incorporated for all Ss. It involved the use of instructions previously employed by Trabasso, Deutsch and Gelman (1960) in their investigation of reversal shifts with young Ss. They found that the simple statement "That game is finished, now we will start a new one," significantly reduced the number of trials to reach criterion.

Method

Experimental Design

The experimental task was the reversal-nonreversal shift paradigm illustrated in Chapter I. The overall design was a 2 x 2 x 2 factorial analysis of variance with two relevant dimensions (brightness and size), two pretraining conditions (control and simultaneous labeling) and two types of transfer tasks (reversal and nonreversal).

Subjects

The Ss were 53 preschool children enrolled in the University Nursery School. Five Ss were dropped because of their inability to reach criterion on the initial learning task. Of the 48 remaining Ss, 32 had participated in the first experiment and 16 were new. The Ss were assigned at random to the eight experimental conditions within the new- and old-subject classifications. As a result, there were four old and two new Ss in each condition. The age of the Ss ranged from 38 to 59 months with a mean of 50.68 months.

Apparatus

The apparatus used in the first experiment and described in Chapter III was employed in Experiment II.

Stimulus Materials

The same stimulus materials were used in both the verbal pretraining conditions and the reversal-nonreversal shift paradigm. These stimuli were the same slides as were used in the learning and transfer trials of Experiment I as described in Chapter III.

Pretraining Procedures

Each S was seen in one individual session which lasted from ten to fifteen minutes. The Ss in the two verbal pretraining conditions (verbal-size and verbal-brightness) were presented with twenty randomly selected pairs of the stimuli in the apparatus immediately before the actual learning trials of the reversal-nonreversal shift paradigm. They were given the following instructions:

> "Here are two pictures. Can you tell me which one is big (black) and which one is small (white)?"
>
> "Here are two other pictures. Which is big (black) and which is small (white). Point to them and tell me."

The S responded to each of the twenty pairs by pointing to each member and giving it the appropriate verbal label. The left-right position of the black-white and big-small cues was random.

All Ss given the verbal-label pretraining were able to follow th procedures accurately.

Reversal-Nonreversal Shift Procedures

The procedures used in the learning and transfer trials of the reversal-nonreversal shift paradigm were the same as those used in the first experiment with the following two additions fo all Ss: (a) during the learning trials a correction procedure was used which required the S, if his first stimulus choice was incorrect, to make a correct response and receive a marble reinforcement on every trial, and (b) after criterion was reached on the learning trials and the two transfer tasks were iniated, the following statement was read: "That game is over, now we will start a new one," was read.

Results

The data were analyzed separately for the learning and transfer phases of Experiment II. The analysis of the learning data was conducted to determine if the speed of learning was (a) related to the dimension (brightness vs. size) relevant during the learning trials, (b) influenced by the verbal labeling pretraining, and (c) reduced as a result of the correction procedure. A second analysis was conducted on the transfer trials. It is against this data that the test of the effectiveness of training in the use of relevant verbal labels and the hypothesized facilitation of reversal shifts is conducted. In addition to this test of the main purpose of this paper, the transfer data was analyzed to determine (a) if the instructional "set" at-time-of-shift reduced the number of trials needed to reach criterion on transfer when compared to the first experiment, and (b) if the dimension relevant during the learning trials was related to the performance of reversal and nonreversal shifts.

Learning

An analysis of variance of the number of trials to reach criterion during learning, summarized in Table 8 , revealed no significant effects attributable to any of the independent variables (verbal pretraining, relevant dimension or type of shift). The only effect which produced an F value greater than 1.00 ($F = 2.15$, $df = 1/40$, $p > .05$) was associated with the verbal treatments.

Table 9 shows the mean number of trials needed to reach criterion on the learning task for each experimental condition. In all four conditions where the Ss received verbal pretraining, a fewer number of trials were required to reach criterion than in the control conditions. Apparently the verbal pretraining facilitated speed of learning but not to a degree that was statistically significant.

The hypothesis that the brightness dimension would be easier for Ss of this age to learn was not confirmed. The F ratio associated with the independent variable of relevant dimension

TABLE 8

Analysis of Variance of Number of Trials to Reach Criterion on Learning Task

Experiment II

Source	df	MS	F[2]	p
Pretraining (P)	1	352.08	2.15	>.05
Dimension (D)	1	40.33		
Shift (S)	1	161.33		
P x D	1	4.08		
P x S	1	80.08		
D x S	1	33.33		
P x D x S	1	14.08		
Within	40	163.52		
Total	47			

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[2] The number of F ratios of less than 1 in this analysis of variance exceeds the number expected by chance. F ratios of less than 1 can result from heterogeneity of within-cell variance or be a reflection of an unknown systematic factor not included in the analysis of variance model.

TABLE 9

Mean Number of Trials to Reach Criterion on Learning Task

Experiment II

Type of Shift	Dimension Relevant	Pretraining Condition	
		Verbal	Control
Reversal	Brightness	15.67	24.17
	Size	15.83	23.50
Nonreversal	Brightness	17.33	18.50
	Size	12.17	16.67

was less than 1.00. In fact, the obtained mean for the brightness-control condition was 21.33 while that of the size-control condition was 20.08.

Transfer

The analysis of variance of the transfer data is summarized in Table 10. Only the effect due to type of shift was significant ($F = 56.19$, $df = 1/40$, $p < .001$). The reversal shift ($\bar{X} = 13.12$) was significantly easier than the nonreversal shift ($\bar{X} = 63.08$) over all conditions. This is consistent with the results obtained in the first experiment although the difference is greater. An examination of the means shown in Table 11 for all eight experimental conditions reveals that the main effects for the reversal-nonreversal differences were consistent over all other variables.

Contrary to predictions there was no significant effect associated with either the dimension relevant during the initial learning or with the verbal pretraining conditions. Both F values were less than 1.00. In addition, the correlations between learning and reversal shift performance ($r = -.089$) and learning and nonreversal shift performance ($r = .089$) were not significant ($p > .05$).

TABLE 10

Analysis of Variance of Number of Trials to Criterion on Transfer Task

Experiment II

Source	df	MS	F[3]	p
Pretraining (P)	1	266.02		
Dimension (D)	1	42.18		
Shift (S)	1	29950.02	56.19	<.001
P x D	1	165.02		
P x S	1	475.02		
D x S	1	46.02		
P x D x S	1	31.69		
Within	40	533.36		
Total	47			

---

[3] The number of F ratios of less than 1 in this analysis of variance exceeds the number expected by chance. F ratios of less than 1 can result from heterogeneity of within-cell variance or be a reflection of an unknown systematic factor not included in the analysis of variance model.

TABLE 11

Mean Number of Trials to Criterion
On Transfer Task
Experiment II

Type of Shift	Dimension Relevant	Pretraining Condition	
		Verbal	Control
Reversal	Brightness	11.33	15.00
	Size	13.33	12.83
Nonreversal	Brightness	64.00	58.33
	Size	73.17	56.83

Discussion

As in Experiment I, the prediction central to this paper of the relative ease of a nonreversal shift over a reversal shift for three- and four-year-old Ss was again not substantiated. Contrary to expectations the reversal shift was consistently easier with or without the requirement to label the stimuli during pretraining. In addition, although the literature indicates brightness to be a dominant attending dimension over size for Ss of this age, there were no differences in speed of learning or in ability to make either a reversal or a nonreversal shift more quickly in relation to the dimension relevant during the learning trials. Thus neither verbal labeling training nor the relevant dimension were related to the ease of performing reversal or nonreversal shifts.

An interesting aspect of this second experiment concerns a comparison of the resulting data with that obtained from the first experiment. It will be recalled that two procedures (correction and instructions at-time-of-shift) were initiated in the second experiment to reduce the within-cell variances and the difficulty of both the learning and transfer tasks. When the mean number of trials to reach criterion on learning over all conditions for the first and second experiments ($\overline{X} = 51.62$, $\overline{X} = 17.83$) as well as the average variances ($\overline{S}^2 = 1554.70$, $\overline{S}^2 = 163.87$) are compared, the conclusion that the correction procedure used in the learning trials did accomplish its purpose appears to be justified. However, although the control conditions were an exact replication of the first experiment, there are two additional factors which may have influenced these differences: (a) two-thirds of the Ss in the second experiment were experienced with the tasks although their learning rate did not differ significantly from the one-third who were inexperienced ($t = 1.03$, $df = 46$, $p > .05$) and, (b) a three month period of time elapsed between the conclusion of the first experiment and the beginning of the second. These factors will be discussed further in the following chapter.

The same comparisons of means across experiments for the performance on the transfer tasks cannot be made because of the extreme differences in the data obtained in the reversal shift condition as compared to the nonreversal, especially in the second experiment. The mean number of trials to reach criterion and the average variance for reversal and nonreversal shifts (collapsed across all other independent variables) for the first and second experiments are reported in Table 12. In both experiments the reversal shift transfer task was performed significantly more rapidly than the nonreversal shift. However, in Experiment II the mean number of trials to criterion for the reversal shift was reduced very close to the absolute minimum of ten while the mean number of trials to criterion for the nonreversal shift was even slightly higher than in Experiment I. In addition, the variance for the nonreversal shift data of Experiment II was higher than

TABLE 12

Average Means and Variances for Transfer Tasks

Experiments I and II

Type of Shift	I	II
Reversal	$\bar{X} = 43.52$	$\bar{X} = 13.12$
	$\bar{S}^2 = 754.96$	$\bar{S}^2 = 20.27$
Nonreversal	$\bar{X} = 60.39$	$\bar{X} = 63.08$
	$\bar{S}^2 = 574.86$	$\bar{S}^2 = 1047.95$

any other obtained. It appears that the instruction at the time of the shift had a marked facilitating effect on the reversal shift while it appears to have had an interfering effect on the nonreversal shift.

Chapter V

DISCUSSION

The results of the two experiments did not support the hypothesis that providing three- and four-year-old children with training in the use of verbal labels for the cues of stimuli will facilitate their subsequent performance of reversal and nonreversal shift transfer tasks. In addition, there was no evidence found to support the hypothesized difference in the ability of three- vs. four-year-old children to profit from such training. The only variation noted in relation to age was that the three-year-old _S_s took longer than the four-year-old _S_s to reach criterion on all tasks. The most interesting and consistent finding in both experiments was the relative ease of the reversal shift transfer task over the nonreversal shift. Such a finding is in conflict with the assumption, based on both verbal mediation theory and previous experimental results, that children of this age will perform a nonreversal shift more rapidly because they are not yet proficient in the use of verbal mediating responses.

The relative ease of performing the reversal shift over the nonreversal shift was noted after completion of the first experiment. It was thought that this finding may have been a result of the use of only the brightness dimension as relevant during the learning trials. Previous experimental results have indicated that young children tend to attend to color or brightness more than to size. In principle, a dominant attending response related to the relevant dimension during the initial learning task will facilitate a reversal shift. A test of this hypothesis was made in the second experiment; the performance of reversal shifts with size relevant was compared to reversal shifts with brightness relevant. There were no differences in performance due to this variable. Reversal shifts were easier to perform than nonreversal shifts no matter which dimension was relevant. If these results are interpreted according to the verbal mediation hypothesis, the conclusion would be drawn that the Ss were proficient in the use of implicit verbal mediating responses and hence performed reversal shifts more quickly than nonreversal shifts. However, this is only indirect evidence in support of verbal mediation. The variable responsible for the ease of a reversal shift was not experimentally demonstrated.

It will be recalled that the primary purposes of these experiments were to investigate the role of verbal responses in discrimination learning and to determine if Ss who do not normally use such responses can be trained to do so. These purposes are based on the assumption that the Ss perform nonreversal shifts more readily than reversal shifts. When this is not the case, the experimental design does not permit examination of the predicted facilitating effects on reversal shifts.

Despite the difficulties in demonstrating the predicted effects on the transfer performance from the verbal pretraining conditions, it is possible to anticipate that these conditions would have an effect on the speed of learning the original discrimination. Pretraining with relevant verbal labels for the cues of a given dimension hypothetically increases the probability of attending to that dimension to the exclusion of the other. Based on several recent discussions (Wolff, 1967; Smiley & Weir, 1966; and Lovejoy, 1966) of the role of attending responses in discrimination learning, the conclusion can be drawn that the initial probability of attending to a dimension is directly related to the rapidity of learning. In both of the present experiments, one cue of the same dimension on which pretraining had been based was relevant for the initial learning trials. Thus, Ss who received pretraining would learn the initial task more rapidly. In Experiment I, Ss in the two verbal pretraining conditions did learn significantly more quickly than those in the control conditions. In Experiment II, although there was some evidence for facilitation of speed of learning, the effect did not reach statitistical significance perhaps because almost all of the Ss learned the initial discrimination in fewer than 25 trials.

In addition to the relationship between verbal pretraining and speed of learning, previous investigators (Kendler & Kendler, 1959; Kendler, Kendler & Learnard, 1962; and Wolff, 1967) have found a positive correlation between speed of learning and subsequent reversal shift performance. The first Kendler (1959) study mentioned above found this relationship using the classical reversal-nonreversal shift paradigm while the other two obtained a similar relationship with the K, K & L optional shift technique. It should be noted that the measure adopted in the optional shift procedure differes substantially from those adopted in other techniques; i.e., in the optional shift procedure the measure reflects the choice of one shift over another rather than the comparison of the speed of performance of both shifts. Kendler, Kendler and Learnard interpret their evidence as supporting verbal mediation theory. They suggest that the effective use of verbal mediators by S facilitates initial learning as well as reversal shift performance, the mediational unit being relevant for both. On the other hand, Wolff, in a discussion of the same correlation, has proposed that it is the result of a dominant attending response to the particular dimension which was relevant in both the learning trials and reversal shift transfer task. Which theoretical position is valid remains to be adequately demonstrated.

Nonetheless, the results of the present experiments were not consistent with the findings of these previous authors. No correlation was found between the speed of learning and the performance of the reversal shift transfer task. Because this correlation was not obtained, it could be concluded that the performance of the reversal shift was not controlled to a significant degree by either verbal mediating responses or dominant dimensional attending responses. This is in contrast to the conclusion, which could be drawn on the basis of the finding of consistent relative ease of the reversal shift, that the Ss were using verbal mediating responses. The validity of either interpretation cannot be determined in the present investigation. However, these results, which are not consistent with previously reported results and theoretical discussions, question the verbal mediation hypothesis.

As previously discussed, in the second experiment no relationship was found between the dimension relevant (size vs. brightness) and the ability to learn the initial discrimination or perform a reversal shift. Ss trained in the brightness dimension were predicted to take fewer trials to learn the initial discrimination and to perform the reversal shift. This prediction was based on previous experimental results (Trabasso, Deutsch & Gelman, 1966; and Suchman & Trabasso, 1966a) which indicated brightness to be the dominant dimension for Ss of this age. A possible reason for not obtaining the predicted results may have been due to inadequate control of the variable of dimensional dominance. The developmental trend indicating brightness to be a dominant dimension over size is obtained by averaging over individuals; at any one age level, although Ss definitely do show a preference for one dimension, it is not necessarily the same dimension preferred by the majority of Ss in the same age range. A more adequate examination of the role of dominant attending responses would demand a test of each S for his dimensional dominance and then assigning him to the appropriate experimental condition of the reversal-nonreversal shift paradigm. Classifying Ss in this manner warrants further investigation in relation to discrimination learning and problem solving.

In addition to these results which are not in support of the verbal mediation hypothesis, in the analysis of the data of the first experiment, it was noted that the means and variances were much higher than is typically found. These facts suggest that the discrimination tasks were quite difficult for some of the Ss and that they were required to work at the experimental task for an extended period of time relative to other experiments with preschool children. In the first experiment 18 Ss were dropped because of their inability to learn the initial discrimination. In addition, an average period of time of 30 minutes was required of each S to complete the task. This lengthy time requirement for preschool children results in decreased attention to the task and an increase in responses to cues in the experimental setting which are irrelevant to the task.

In order to decrease the task difficulty and thereby reduce the amount of time needed to complete the discrimination tasks, two procedural changes were made in the second experiment: (a) the use of a correction procedure throughout the learning trials and, (b) the introduction of an instructional "set" at the beginning of the transfer tasks. When the data from the second experiment were compared to those of the first, several important differences were noted.

First, the mean number of trials to reach criterion on the learning task dropped from 51.62 in the first experiment to 17.83 in the second. In Experiment II the fewer number of trials needed to learn the task was consistent over all experimental conditions. That neither verbal pretraining nor relevant dimension had an effect on the rate of learning would indicate that the correction procedure was responsible for the differences between Experiments I and II. Nevertheless, other variables may account for the differences in the two experiments. The first experiment was conducted in September with the majority of the investigation being conducted in the University Nursery School. The second experiment, conducted entirely in the same school, took place in January. Many changes were observed between the two situations. At the time of the earlier experiment, school had been in session only a few weeks. The children were new to each other, to the teachers, and to the school setting. They displayed some tension as evidenced by crying and calling for parents. In addition, the conduct of the classes was very systematic and scheduled. When the second experiment was begun four months later, the children were relaxed, open and gregarious. At that time the conduct of the classes was more flexible, more relaxed and less scheduled than at the beginning of the fall term.

The situational differences in the two experiments may also explain the reduction in the average amount of time required by each subject to complete the tasks. In September, in addition to the average 30 minute period of time spent in the actual experiment with each child, it was necessary for E to spend an average of one hour per child in the activities of the nursery school in order to become acquainted with the children and to gain their confidence. In January, the average actual experimental time dropped from 30 to 10 minutes, and no extra-experimental time was required, even for the class not familiar with the E. The children were enthusiastic about participating in the experiment. Their motivation and interest were extremely high.

Such situational variables as have been discussed can play an extremely important role in research with young children. In fact, they might well have accounted for a large proportion of the reduction of the variance and mean number of trials to criterion. As noted by a number of other investigators, effective experimental research with young children requires an adaptation period during which the child becomes familiar with the school, his peers, the E, the apparatus, the experimental room, and so on before the experiment is begun.

The previous discussion of the differences between Experiments I and II was only in relation to the learning trials. A comparison of the data from the transfer tasks of the two experiments also revealed some interesting findings. When the results for only the reversal shift transfer task are compared across experiments, there is once again evidence of a significant reduction in both the means and variances. This can tentatively be attributed to the use of the instructional "set" introduced at the time of the shift to the transfer tasks.

The effectiveness of the "set" is even more apparent when the results of the nonreversal shift conditions are examined. Unlike the extreme facilitating effects which the "set" had on the reversal shift, there was a marked negative effect on the nonreversal shift conditions. The means and variances for the nonreversal shift conditions of Experiment II, in contrast to the results of all other comparisons between experiments, were even higher than those obtained in the first experiment; an interference effect on the nonreversal shift that is difficult to explain. However, if all Ss can be assumed, on the basis of the overall ease of the reversal shift, to have been proficient in the use of verbal mediating responses, then a hypothetical description of the effect of the instructional set is possible.

It will be recalled that, as discussed in the previous chapter, young children with limited problem-solving experience tend to continue using a previously correct response because they do not correctly interpret the cessation of reinforcement. Hypothetically, the instructional "set" at the time of the shift to the transfer task reduces this tendency and increases the probability that the S will make an alternative response within the first few trials of the transfer task. The question remains as to which of the three alternative responses he will be most likely to choose.

If the S was using a verbal mediating response for the dimension relevant during the initial learning task or, for that matter, was responding within his dominant dimension, the opposite cue of that dimension would have the greatest probability of being chosen after cessation of the old response. It can therefore be seen that the instructional "set" cues the S to stop the old response and to make another choice. Thus, the reversal shift is facilitated. On the other hand, in the nonreversal shift condition the "set" will again signal the S to stop his old response but the S who is a mediator will tend to respond to the opposite cue of the previously relevant dimension; a cue that is now inappropriate for the nonreversal shift. Nonetheless, responses to this cue will be partially reinforced, thus maintaining performance of the incorrect response and reducing the probability of the S making an alternate response to either of the cues of the other dimension. Therefore, the difficulty of performing a nonreversal shift is increased.

An examination of the first, second, and third trial responses of Ss in the nonreversal shift condition indicated that over half of them did change their response to the opposite cue of the dimension relevant in the learning trials. The majority of the remaining Ss perservered in their originally learned responses which were also being intermittently reinforced. Only a few Ss made a series of three or more responses to a cue of the other dimension within the first 15 trials of the transfer task. A similar examination of the responses in the first three trials of the transfer task for the reversal shift condition revealed that almost all the Ss made a response to the opposite cue of the relevant dimension, received reinforcement, and did not make any errors after this.

In conclusion, the results of these two experiments did not clarify the hypothetical role played by verbal mediating responses in the problem-solving ability of preschool Ss. However, they did emphasize the importance of other variables in the experimental situation which are of extreme importance for work with young children who have limited problem-solving experience.

As the work of Luria (1957) and others has indicated, the ability of a preschool child to perform successfully an experimental task depends to a great extent upon communicating the task requirements to him. In Luria's research he found indications that a child's ability to respond selectively to a figure-ground relationship was dependent upon casting the relevant cues in a story context (i.e., when the sun is out, the sky is yellow). In addition to the importance of the child understanding a verbal command, Luria also emphasized that in the early stages of development the mobility of the nervous processes are quite inadequate and that the connections evoked by a work possess considerable inertia. That is, there may be a time-lag between even a simple verbal command and its execution.

These and similar factors may be key variables in the understanding of the apparent inability of young children to perform certain experimental tasks. In the present experiments the power of the instructional "set" at the time of the shift in facilitating reversal shifts is an excellent example of the importance of these factors. More data on the control and use of such variables are needed for adequate research with young children.

Chapter VI

SUMMARY

Two experiments were conducted in an attempt to determine the relationship between verbal labeling responses and performance of reversal and nonreversal shift discrimination tasks. Previous experimental results and verbal mediation theory led to the assumption that young children of three and four years of age would perform a nonreversal shift more rapidly than a reversal shift. It was hypothesized that pretraining with relevant verbal labels for the cues of one dimension of the stimuli would reverse this effect, especially for the younger _S_s.

In the first experiment _S_s (N = 96) were randomly assigned to each of four experimental pretraining conditions. These conditions consisted of two levels of verbal pretraining and two control conditions. In the first verbal pretraining condition _S_s were required to label the brightness cues of the stimuli as they were successively presented in black-black and white-white pairs; the dimensional relationship of these cues was omitted. In the other verbal pretraining condition, the _S_s were required to label the brightness cues as they were presented in simultaneous black-white pairs; the dimensional relationship of the cues was emphasized and labeled. In the first control condition the Ss were required to make irrelevant same-different judgments of the stimuli which were randomly paired. This condition was included to control for warm-up and learning-how-to-learn effects. A final condition was an absolute control in which the Ss did not receive pretraining of any sort.

The results of Experiment I were not consistent with the assumed relative ease of reversal over nonreversal shifts for young children. The reversal shift was found to be easier than the nonreversal shift for all Ss in all conditions. However, the three-year-old Ss consistently took a greater number of trials to reach criterion than did the four-year-old Ss. In addition to the unexpected ease of the reversal shift, it failed to be differentially associated with the verbal pretraining conditions, although there was some indication that the verbal pretraining interfered in the performance on the nonreversal shift transfer task.

The analysis of the results of the first experiment when compared to those of previous reversal-nonreversal shift studies revealed unusually high means and variances for both the learning and transfer tasks. Accordingly, it was postulated that both tasks as employed in this experiment were relatively difficult for the three- and four-year-old children to perform. Therefore, a second experiment was conducted in which two procedural changes designed to reduce the task difficulty were incorporated for all Ss (N = 48): (a) the use of a correction procedure throughout the learning trials and, (b) the incorporation of an instructional "set" at the time of the shift to the transfer trials.

In addition to the incorporation of the procedural changes and the investigation of the effect of simultaneous verbal pretraining vs. an absolute control condition, the dimension relevant during initial learning was examined as an independent variable in Experiment II. Previous research has indicated that Ss of this age as a group show a higher probability of attending to brightness over size when these two dimensions are included in a discrimination task. Therefore, it was hypothesized that the relative ease of the reversal shift obtained in Experiment I may have been a result of the fact that brightness had been the only relevant dimension for pretraining and for the learning trials. Based on the hypothetical role of dominant attending responses in reversal-nonreversal shift discrimination, in Experiment II it was predicted that there would be a significant relationship between the relevant dimension and the relative ease of a reversal shift.

The analysis of Experiment II again demonstrated that reversal shifts were consistently performed more rapidly than nonreversal shifts over all conditions. In fact, the relative ease and difficulty of the two shifts was even more disparate than in the first experiment. Furthermore, there were no significant effects related to either the verbal pretraining or the dimension relevant during the learning trials.

A comparison of the learning task data of the two experiments revealed that there had been a great reduction in both the mean number of trials to reach criterion and the average variance from the first to the second experiment. This was attributed to the use of the correction procedure during the learning trials of the second experiment. There was also, as predicted, a reduction in the means and average variance on the reversal shift transfer task as a result of the use of the instructional "set" at the time of the shift. However, there was an unanticipated increase in both the mean number of trials to criterion and the average variance for the nonreversal shift condition.

In the discussion section it was tentatively concluded that the overall relative ease of the reversal shift over the nonreversal shift obtained in both experiments was due to the fact that the Ss were already proficient in the use of verbal mediating responses. The comparatively fewer number of trials needed to learn the initial discrimination in the second experiment, in addition to being a result of the incorporation of the correction procedure, was also related to situational factors such as the atmosphere in the school and the security of the peer group. The effect of the instructional "set" was theoretically described in relation to the more extreme discrepancy found between the ease of a reversal shift and the difficulty of a nonreversal shift found in Experiment II. The "set" hypothetically cued the Ss to discard the previously reinforced response and make a second choice. The opposite cue of the previously relevant dimension was shown to be the most probable second choice when the Ss are assumed to be verbal mediators. Hence the "set" facilitated the reversal shift and interfered with the nonreversal shift.

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APPENDIX A

Means and Variances

TABLE 13

Means and Variances of Trials to Criterion on Learning Task: Experiment I

Type of Shift	Pretraining Conditions			
	Absolute Control	Same-Diff. Control	Successive Labeling	Simultaneous Labeling
Age 3				
Reversal	26.17	53.67	36.33	36.67
	260.97	1131.47	801.47	407.87
Nonreversal	51.17	106.50	33.33	45.83
	767.77	1277.10	625.87	770.57
Age 4				
Reversal	50.67	77.50	13.83	37.67
	1472.27	1871.90	17.77	2431.47
Nonreversal	43.17	75.83	63.50	74.00
	2148.57	3312.97	1683.50	5893.60

TABLE 14

Means and Variances of Trials to Criterion on Transfer Task: Experiment I

Type of Shift	Pretraining Condition			
	Absolute Control	Same-Diff. Control	Successive Labeling	Simultaneous Labeling
Age 3				
Reversal	52.00	57.67	58.83	32.83
	1357.60	883.07	898.57	763.77
Nonreversal	55.50	77.00	73.00	61.00
	627.50	384.00	557.20	568.00
Age 4				
Reversal	32.50	44.17	36.17	34.00
	692.30	647.77	369.77	288.80
Nonreversal	46.17	41.83	60.83	67.83
	674.17	578.17	438.17	909.77

TABLE 15

Means and Variances of Trials to Criterion on Learning Task: Experiment II

		Pretraining Condition	
Type of Shift	Relevant Dimension	Verbal	Control
Reversal	Brightness	$\bar{X}$ = 15.67 S^2= 53.87	$\bar{X}$ = 24.16 S^2= 753.36
	Size	$\bar{X}$ = 15.83 S^2= 83.36	$\bar{X}$ = 23.50 S^2= 304.30
Nonreversal	Brightness	$\bar{X}$ = 17.33 S^2= 7.07	$\bar{X}$ = 18.50 S^2= 58.70
	Size	$\bar{X}$ = 12.17 S^2= 15.37	$\bar{X}$ = 16.67 S^2= 33.47

TABLE 16

Means and Variances of Trials to Criterion
on Transfer Task: Experiment II

Type of Shift	Relevant Dimension	Pretraining Condition	
		Verbal	Control
Reversal	Brightness	$\bar{X} = 11.33$ $S^2 = 10.67$	$\bar{X} = 15.00$ $S^2 = 22.80$
	Size	$\bar{X} = 13.33$ $S^2 = 29.87$	$\bar{X} = 12.83$ $S^2 = 17.77$
Nonreversal	Brightness	$\bar{X} = 64.00$ $S^2 = 840.40$	$\bar{X} = 58.33$ $S^2 = 1369.07$
	Size	$\bar{X} = 73.17$ $S^2 = 881.37$	$\bar{X} = 56.83$ $S^2 = 1100.97$

APPENDIX B

Raw Data

TABLE 17

Number of Trials to Criterion on Learning for Three-Year-Old Ss: Experiment I

Type of Shift	Pretraining Conditions			
	Absolute Control	Same-Diff. Control	Successive Labeling	Simultaneous Labeling
Reversal	10	91	73	30
	24	92	69	41
	10	62	14	42
	48	35	36	71
	43	10	15	12
	22	32	11	24
Nonreversal	90	118	61	31
	24	85	41	36
	81	173	10	92
	29	74	63	50
	45	91	15	10
	38	98	10	56

TABLE 18

Number of Trials to Criterion on Learning for Four-Year-Old Ss: Experiment I

Type of Shift	Pretraining Conditions			
	Absolute Control	Same-Diff. Control	Successive Labeling	Simultaneous Labeling
Reversal	37	14	14	16
	53	80	21	137
	10	40	10	10
	117	126	16	22
	66	90	12	31
	21	115	10	10
Nonreversal	13	10	12	137
	12	110	61	13
	20	10	35	19
	16	64	49	10
	125	113	116	70
	73	148	108	195

TABLE 19

Number of Trials to Criterion on Transfer
for Three-Year-Old _Ss_: Experiment I

Type of Shift	Pretraining Condition			
	Absolute Control	Same-Diff. Control	Successive Labeling	Simultaneous Labeling
Reversal	85	52	85	11
	85	17	85	18
	85	29	48	30
	13	78	29	39
	12	85	21	14
	32	85	85	85
Nonreversal	24	85	85	40
	85	37	72	85
	56	85	85	22
	39	85	26	79
	44	85	85	55
	85	85	85	85

TABLE 20

Number of Trials to Criterion on Transfer for Four-Year-Old Ss: Experiment I

Type of Shift	Pretraining Condition			
	Absolute Control	Same-Diff. Control	Successive Labeling	Simultaneous Labeling
Reversal	16	23	33	45
	85	18	53	20
	15	36	25	56
	26	40	62	25
	24	85	23	13
	29	63	21	45
Nonreversal	52	35	62	85
	12	85	39	11
	63	28	85	85
	85	44	56	85
	31	14	38	85
	34	45	85	56

TABLE 21

Number of Trials to Criterion on Learning:

Experiment II

Dimension Relevant	Pretraining Condition	
	Verbal	Control
Brightness	21*	17
	28*	14
	10	11*
	14	11
	10	80*
	11	12
	17*	10*
	20*	12*
	14	13
	16	23
	16	26
	21	27
Size	14	10*
	15*	43
	12*	48*
	34	19
	10	11
	10	10
	10*	10
	10*	21*
	20	14
	11	26
	10	15*
	12	14

* new subjects

TABLE 22

Reversal Shift Transfer Task: Experiment II

Number of Trials to Criterion

Dimension Relevant	Pretraining Condition	
	Verbal	Control
Brightness	18*	13
	10*	12
	10	21*
	10	21
	10	10
	10	13
Size	12	20*
	10*	11
	14*	10*
	24	16
	10	10
	10	10

* new subjects

TABLE 23

Nonreversal Shift Transfer Task: Experiment II

Number of Trials to Criterion

Dimension Relevant	Pretraining Condition	
	Verbal	Control
Brightness	100*	91*
	40*	26
	37	81
	100	40
	60	12*
	47	100
Size	98*	15
	100*	72*
	53	81
	55	100
	33	47*
	100	26

* new subjects